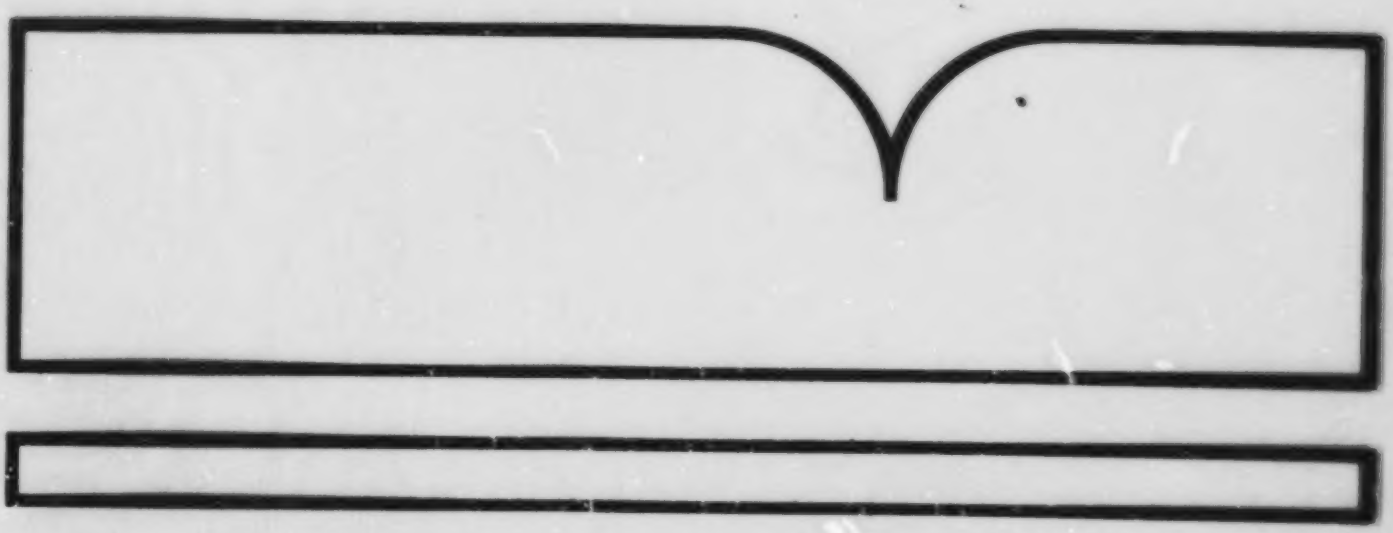
PB85-122505

Pesticide Registration Standard
Chlorsulfuron (Glean)

(U.S.) Environmental Protection Agency
Washington, DC

1982



U.S. Department of Commerce
National Technical Information Service
NTIS

PB85-122505

CHLORSULFURON (Glean)

2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benzenesulfonamide

PESTICIDE REGISTRATION STANDARD

EPA-540-RS-82-011

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REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2. Recipient's Accession No. PB85 122505
4. Title and Subtitle: Pesticide Registration Standard - Chlorsulfuron (Glean)		5. Report Date 9/82
		EPA-540/RS-82-011
7. Author(s): USEPA, Office of Pesticide Programs, Registration Division		8. Performing Organization Rept. No.
9. Performing Organization Name and Address: Environmental Protection Agency, Office of Pesticide Programs, 401 M. St. SW (TS-767c), Washington, DC 20460		10. Project/Task/Work Unit No.
		11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address: same as #9		13. Type of Report & Period Covered
		14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This document contains information regarding reregistration of pesticide products containing the subject active ingredient. The document includes how to register under a registration standard, regulatory position and rationale, and summaries of data requirements and data gaps. Also included is a bibliography containing citations of all studies reviewed by EPA in arriving at the positions and conclusions contained in the standard.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement:	19. Security Class (This Report)	21. No. of Pages
	20. Security Class (This Page)	22. Price

(See ANSI-Z39.18) See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

ADDENDUM

The registration standard for Chlorsulfuron (Glean) was prepared jointly by EPA's Office of Pesticide Programs (EPA/OPP) and E. I. duPont de Nemours & Co. Further information regarding this standard may be obtained from the Product Manager, Mr. Robert Taylor, EPA/OPP, 401 M Street, S.W., Washington, D.C. 20460, telephone (703) 557-1800.

Chlorsulfuron Registration Standard

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HOW TO REGISTER

UNDER A REGISTRATION STANDARD

Organization of the Standard

This first chapter explains the purpose of a Registration Standard and summarizes the legal principles involved in registering or reregistering under a Standard. The second chapter sets forth the requidrements that must be met to obtain or retain registration for products covered by this particular Registration Standard. In the remaining chapters the Agency reviews the available data by scientific discipline, discusses the Agency's concerns with the identified potential hazards, and logically develops the conditions and requirements that would reduce those hazards to acceptable levels.

Purpose of the Standard

Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides that "no person in any State may distribute, sell, offer for sale, hold for sale, ship, deliver for shipment, or receive (and having so received) deliver or offer to deliver, to any person any pesticide which is not registered with the Administrator (of EPA)." To approve the registration of a pesticide, the Administrator must find, pursuant to Section 3(c)(5), that:

"(A) its composition is such as to warrant the proposed claims for it;
(B) its labeling and other material required to be submitted comply with the requirements of this Act;
(C) it will perform its intended function without unreasonable adverse effects on the environment; and
(D) when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment."

In making these findings, the Agency reviews a wide range of data which registrants are required to submit and assesses the risks and benefits associated with the use of the proposed pesticide. But the established approach to making these findings has been found to be defective on two counts.

First, EPA and its predecessor agency, the United States Department of Agriculture (USDA), routinely reviewed registration applications on a "product by product" basis, evaluating each product-specific application somewhat independently. In the review of products containing similar components, there was little opportunity for retrospective review of the full range of pertinent data available in Agency files and in the public literature. Thus the "product by product" approach was often inefficient and sometimes resulted in inconsistent or incomplete regulatory judgments.

Second, over the years, as a result of inevitable and continuing advances in scientific knowledge, methodology, and policy, the data base for many pesticides came to be considered inadequate by current scientific and regulatory

standards. Given the long history of pesticide regulation in several agencies, it is even likely that materials may have been lost from the data files. When EPA issued new requirements for registration in 1975 (40 CFR 162) and proposed new guidelines for hazard in 1978 (43 FR 29686, July 10, 1978, and 43 FR 37336, August 22, 1978), many products that had already been registered for years were being sold and used without the same assurances of human and environmental safety as were being required for new products. Because of this inconsistency, Congress directed EPA to reregister all previously registered products, so as to bring their registrations and their data bases into compliance with current requirements. [See FIFRA Section 3(g)].

Facing the enormous job of re-reviewing and calling-in new data for the approximately 35,000 current registrations, and realizing the inefficiencies of the "product by product" approach, the Agency decided that a new, more effective method of review was needed.

A new review procedure has been developed. Under it, EPA publishes documents called Registration Standards, each of which discusses a particular pesticide active ingredient. Each Registration Standard summarizes all the data available to the Agency on a particular active ingredient and its current uses, and sets forth the Agency's comprehensive position on the conditions and requirements for registration of all existing and future products which contain that active ingredient. These conditions and requirements, all of which must be met to obtain or retain full registration or reregistration under Section 3(c)(5) of FIFRA, include the submission of needed scientific data which the Agency does not now have, compliance with standards of toxicity, composition, labeling, and packaging, and satisfaction of the data compensation provisions of FIFRA Section 3(c)(1)(D).

The Standard will also serve as a tool for product classification. As part of the registration of a pesticide product, EPA may classify each product for "general use" or "restricted use" [FIFRA Section 3(d)]. A pesticide is classified for "restricted use" when some special regulatory restriction is needed to ensure against unreasonable adverse effects to man or the environment. Many such risks of unreasonable adverse effects can be lessened if expressly-designed label precautions are strictly followed. Thus the special regulatory restriction for a "restricted use" pesticide is usually a requirement that it be applied only by, or under the supervision of, an applicator who has been certified by the State or Federal government as being competent to use pesticides safely, responsibly, and in accordance with label directions. A restricted-use pesticide can have other regulatory restrictions [40 CFR 162.11(c)(5)] instead of, or in addition to, the certified applicator requirement. These other regulatory restrictions may include such actions as seasonal or regional limitations on use, or a requirement for the monitoring of residue levels after use. A pesticide classified for "general use," or not classified at all, is available for use by any individual who is in compliance with State or local regulations. The Registration Standard review compares information about potential adverse effects of specific uses of the pesticide with risk criteria listed in 40 CFR 162.11(c), and thereby determines whether a product needs to be classified for "restricted use." If the Standard does classify a pesticide for "restricted use," this determination is stated in the second chapter.

Requirement to Reregister Under the Standard

FIFRA Section 3(g), as amended in 1978, directs EPA to reregister all currently registered products as expeditiously as possible. Congress also agreed that reregistration should be accomplished by the use of Registration Standards.

Each registrant of a currently registered product to which this Standard applies, and who wishes to continue to sell or distribute his product in commerce, must apply for reregistration. His application must contain proposed labeling that complies with this Standard.

EPA will issue a notice of intent to cancel the registration of any currently registered product to which this Standard applies if the registrant fails to comply with the procedures for registration set forth in the Guidance Package which accompanies this Standard.

"Product Specific" Data and "Generic" Data

In the course of developing this Standard, EPA has determined the types of data needed for evaluation of the properties and effects of products to which the Standard applies, in the disciplinary areas of Product Chemistry, Environmental Fate, Toxicology, Residue Chemistry, and Ecological Effects. These determinations are based primarily on the data Guidance prposed in 1978 (43 FR 29696, July 10, 1978, and 43 FR 37336, August 22, 1978), as applied to the use patterns of the products to which this Standard applies. Where it appears that data from a normally applicable Guidelines requirement were actually unnecessary to evaluate these products, the Standard indicates that the requirement has been waived. On the other hand, in some cases studies not required by the Guidelines may be needed because of the particular composition or use pattern of products the Standard covers; if so, the Standard explains the Agency's reasoning. Data guidelines have not yet been proposed for the Residue Chemistry discipline, but the requirements for such data have been in effect for some time and are, the Agency believes, relatively familiar to registrants. Data which we have found are needed to evaluate the registrability of some products covered by the Standard may not be needed for the evaluation of other products, depending upon the composition, formulation type, and intended uses of the product in question. The Standard states which data requirements apply to which product categories. (See the third chapter.) The various kinds of data normally required for registration of a pesticide product can be divided into two basic groups:

(A) data that are "product specific," i.e., data that relate only to the properties or effects of a product with a particular composition (or a group of products with closely similar composition); and

(B) "generic" data that pertain to the properties or effects of a particular ingredient, and thus are relevant to an evaluation of the risks and benefits of all products containing that ingredient (or all such products having a certain use pattern), regardless of any such product's unique composition.

The Agency requires certain "product specific" data for each product to characterize the product's particular composition and physical/chemical properties (Product Chemistry), and to characterize the product's acute toxicity (which is a function of its total composition). The applicant for registration or reregistration of any product, whether it is a manufacturing-use or end-use product, and without regard to its intended use pattern, must submit or cite enough of this kind of data to allow EPA to evaluate the product. For such purposes, "product specific" data on any product other than the applicant's is irrelevant, unless the other product is closely similar in composition to the applicant's. (Where it has been found practicable to group similar products for purposes of evaluating, with a single set of tests, all products in the group, the Standard so indicates.) "Product specific" data on the efficacy of particular end-use products are required where the exact formulation may affect efficacy and where failure of efficacy could cause public health problems.

All other data needed to evaluate pesticide products concern the properties or effects of a particular ingredient of products (normally a pesticidally active ingredient, but in some cases a pesticidally inactive, or "inert," ingredient). Some data in this "generic" category are required to evaluate the properties and effects of all products containing that ingredient (e.g., the acute LD_{50} of the active ingredient in its technical or purer grade; see proposed 40 CFR 163.81-1(a), 43 FR 37355).

Other "generic" data are required to evaluate all products which both contain a particular ingredient and are intended for certain uses (see, e.g., proposed 40 CFR 163.82-1, 43 FR 37363, which requires subchronic oral testing of the active ingredient with respect to certain use patterns only). Where a particular data requirment is use-pattern dependent, it will apply to each end-use product which is to be labeled for that use pattern (except where such end-use product is formulated from a registered manufacturing-use product permitting such formulations) and to each manufacturing-use product with labeling that allows it to be used to make end-use products with that use pattern. Thus, for example, a subchronic oral dosing study is needed to evaluate the safety of any manufacturing-use product that legally could be used to make an end-use, food-crop pesticide. But if an end-use product's label specified it was for use only in ways that involved no food/feed exposure and no repeated human exposure, the subchronic oral dosing study would not be required to evaluate the product's safety; and if a manufacturing-use product's label states that the product is for use only in making end-use products not involving food/feed use or repeated human exposure, that subchronic oral study would not be relevant to the evaluation of the manufacturing-use product either.

If a registrant of a currently registered manufacturing-use or end-use product wishes to avoid the costs of data compensation [under FIFRA Section 3(c)(1)(D)] or data generation [under Section 3(c)(2)(B))]f for "generic" data that are required only with respect to some use patterns, he may elect to delete those use patterns from his labeling at the time he reregisters his product. An applicant for registration of a new product under this Standard may similarly request approval for only certain use patterns.

Data Compensation Requirements Under FIFRA 3(c)(1)(D)

Under FIFRA Section 3(c)(1)(D), an applicant for registration, reregistration, or amended registration must offer to pay compensation for certain existing data the Agency has used in developing the Registration Standard. The data for which compensation must be offered are all data which are described by all of the following criteria:

(1) the data were first submitted to EPA (or to its predecessor agencies, USDA or FDA), on or after January 1, 1970;

(2) the data were submitted to EPA (or USDA or FDA) by some other applicant or registrant in support of an application for an experimental use permit, an amendment adding a new use to a registration, or for reregistration, or to support or maintain an existing registration;

(3) the data are relevant to the Agency's decision to register or reregister the applicant's product under the Registration Standard, taking into account the applicant's product's composition and intended use pattern(s);

(4) the data are determined by EPA to be valid and usable in reaching regulatory conclusions; and

(5) the data are not those for which the applicant has been exempted by FIFRA Section 3(c)(2)(D) from the duty to offer to pay compensation. (This exemption applies to the "generic" data concerning the safety of an active ingredient of the applicant's product, not to "product specific" data. The exemption is available only to applicants whose product is labeled for end-uses for which the active ingredient in question is present in the applicant's product because of his use of another registered product containing that active ingredient which he purchases from another producer.)

An applicant for reregistration of an already registered product under this Standard, or for registration of a new product under this Standard, accordingly must determine which of the data used by EPA in developing the Standard must be the subject of an offer to pay compensation, and must submit with his application the appropriate statements evidencing his compliance with FIFRA Section 3(c)(1)(D).

An applicant would never be required to offer to pay for "product specific" data submitted by another firm. In many, if not in most cases, data which are specific to another firm's product will not suffice to allow EPA to evaluate the applicant's product; that is, will not be useful to the Agency in determining whether the applicant's product is registrable. There may be cases, however, where because of close similarities between the composition of two or more products, another firm's data may suffice to allow EPA to evaluate some or all of the "product specific" aspects of the applicant's product. In such a case, the applicant may choose to cite those data instead of submtting data from tests on his own product, and if he chooses that

option, he would have to comply with the Section 3(c)(1)(D) requirements with respect to each item of "generic" data that relates to his product's intended uses.

Each applicant for registration or reregistration of a manufacturing-use product, and each applicant for registration or reregistration of an end-use product, who is not exempted by FIFRA Section 3(c)(2)(D), must comply with the Section 3(c)(1)(D) requirements with respect to each item of "generic" data that relates to his product's intended uses.

A detailed description of the procedures an applicant must follow in applying for reregistration (or new registration) under this Standard is found in the Guidance Package for this Standard.

Obtaining Data to Fill "Data Gaps;" FIFRA 3(c)(2)(B)

Some of the kinds of data EPA needs for its evaluation of the properties and effects of products to which this Standard applies have never been submitted to the Agency (or, if submitted, have been found to have deficiencies rendering them inadequate for making registration decisions) and have not been located in the published literature search that EPA conducted as part of preparing this Standard. Such instances of missing but required data are referred to in the Standard as "data gaps."

FIFRA Section 3(c)(2)(B), added to FIFRA by the Congress in 1978, authorizes EPA to require registrants to whom a data requirement applies to generate (or otherwise produce) data to fill such "gaps" and submit those data to EPA. EPA must allow a reasonably sufficient period for this to be accomplished. If a registrant fails to take appropriate and timely steps to fill the data gaps identified by a Section 3(c)(2)(B) order, his product's registration may be suspended until the data are submitted. A mechanism is provided whereby two or more registrants may agree to share in the costs of producing data for which they are both responsible.

The Standard lists, in the third chapter, the "generic" data gaps and notes the classes of products to which these data gaps pertain. The Standard also points out that, to be registrable under the Standard, a product must be supported by certain required "product specific" data. In some cases, the Agency may possess sufficient "product specific" data on one currently registered product, but may lack data on another. Only those Standards which apply to a very small number of currently registered products will attempt to state definitively the "product specific" data gaps on a "product-by-product" basis. (Although the Standard will in some cases note which data EPA does possess that would suffice to satisfy certain "product specific" data requirements for a category of products with closely similar composition characteristics.)

As part of the process of reregistrating currently registered products, EPA will issue Section 3(c)(2)(B) directives requiring the registrants to take appropriate steps to fill all identified data gaps -- whether the data in question are "product-specific" or "generic" -- in accordance with a schedule.

Persons who wish to obtain registrations for new products under this Standard will be required to submit (or cite) sufficient "product specific" data before their applications are approved. Upon registration, they will be required under Section 3(c)(2)(B) to take appropriate steps to submit data needed to fill "generic" data gaps. (We expect they will respond to this requirement by entering into cost-sharing agreements with other registrants who previously have been told they must furnish the data.) The Guidance Package for this Standard details the steps that must be taken by registrants to comply with Section 3(c)(2)(B).

Amendments to the Standard

Applications for registration which propose uses or formulations that are not presently covered by the Standard, or which present product compositions, product chemistry data, hazard data, toxicity levels, or labeling that do not meet the requirements of the Standard, will automatically be considered by the Agency to be requests for amendments to the Standard. In response to such applications, the Agency may request additional data to support the proposed amendment to the Standard, or may deny the application for registration on the grounds that the proposed product would cause unreasonable adverse effects to the environment. In the former case, when additional data have been satisfactorily supplied, and providing that the data do not indicate the potential for unreasonable adverse effects, the Agency will then amend the Standard to cover the new registration.

Each Registration Standard is based upon all data and information available to the Agency's reviewers on a particular date prior to the publication date. This "cut-off" date is stated at the beginning of the second chapter. Any subsequent data submissions and any approved amendments will be incorporated into the Registration Standard by means of addenda, which are available for inspection at EPA in Washington, D.C., or copies of which may be requested from the Agency. When all the present "data gaps" have been filled and the submitted data have been reviewed, the Agency will revise the Registration Standard. Thereafter, when the Agency determines that the internally maintained addenda have significantly altered the conditions for registration under the Standard, the document will be updated.

While the Registration Standard discusses only the uses and hazards of products containing the designated active ingredient(s), the Agency is also concerned with the potential hazards of some inert ingredients and impurities. Independent of the development of any one Standard, the Agency has initiated the evaluation of some inert pesticide ingredients. Where the Agency has identified inert ingredients of concern in a specific product to which the Standard applies, these ingredients will be pointed out in the Guidance Package.

II

REGULATORY POSITION

Introduction

This chapter describes the Agency's regulatory position on products which contain chlorsulfuron as the sole active ingredient. The Agency's regulatory position incorporates a number of considerations. Foremost among these considerations is an analysis of the registrability of products containing chlorsulfuron based on the risk criteria found in Section 162.11(a) of Title 40 of the U.S. Code of Federal Regulations. The Agency's determination is presented below, and the rationale for this decision follows the position.

In addition to the basic regulatory decision and rationale, this chapter includes the following: criteria for the registration of chlorsulfuron products under the Standard, acceptable ranges and limits for product composition, acute toxicity, and use pattern/application method; required labeling; and a tolerance assessment.

Description of Chemical

Chlorsulfuron is a herbicide used for selective weed control on wheat, barley, oats, and reduced-tillage fallow systems. The chemical name for chlorsulfuron is 2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benezenesulfonamide. For convenience in writing this Standard the name "chlorsulfuron" will be used instead of the chemical name. Chlorsulfuron is the common name accepted by the American National Standards Institute (ANSI) and is pending for acceptance by the International Standards Organization (ISO).

The only trade name for chlorsulfuron is Glean™ Weed Killer (the trademark of E. I. du Pont de Nemours & Company Inc.). The Chemical Abstracts Registry (CAS) number for chlorsulfuron is 64902-72-3. The OPP (Shaughnessey) number is 118601. The molecular formula is $C_{12}H_{12}ClN_5O_4S$.

Regulatory Position for Products Containing Chlorsulfuron as the Sole Active Ingredient

Chlorsulfuron as described in this Standard may be registered for sale, distribution, formulation, and use in the United States. Based on the review of the data, the Agency finds that none of the risk criteria found in Section 162.11(a) of Title 40 of the U.S. Code of Federal Regulations (CFR) were met or exceeded by chlorsulfuron.

The Agency has considered the data submitted by the registrant up through the time of publication of this Standard. The Agency does not have reason to believe that the use of this herbicide will cause unreasonable adverse effects when used in compliance with proper label directions and precautions. New chlorsulfuron products which fall within the registrable limits described in this Standard may be registered under this Standard and are subject to the same requirements.

Regulatory Rationale

Chlorsulfuron is being used in the United States under EPA Experimental Use Permit No. 352-EUP-105 from March 31, 1981, to March 31, 1984. It is being tested as a 75% dry flowable formulation for selective weed control in wheat, barley, and reduced-tillage fallow systems.

The Agency has concluded that it should register chlorsulfuron and the 75% dry flowable formulation for use on wheat, barley, oats, and reduced-tillage fallow systems, since 1) the data base of scientific studies is nearly complete in the disciplinary areas of Product Chemistry, Environmental Fate, Toxicology, Residue Chemistry, and Ecological Effects, and 2) no adverse effects have been discovered in the review of available studies on chlorsulfuron which are not already adequately addressed by FIFRA labeling requirements. When chlorsulfuron is applied according to label directions, residues do not exceed the established U.S. tolerances. These uses are classified as general use and not restricted.

Criteria for Registration Under the Standard

To be subject to this Standard, chlorsulfuron products must meet the following conditions:

- contain chlorsulfuron as the sole active ingredient or contain chlorsulfuron in a mixture which has the same use patterns described in this Standard;
- be within acceptable standards of product composition;
- be of the same formulation type addressed in this standard;
- be within acceptable acute toxicity limits;
- be within acceptable limits for application frequency, rate, and methodology;
- be labeled for acceptable end-uses; and
- bear required labeling.

Technical and manufacturing use chlorsulfuron products must bear label directions for formulation into acceptable end-use products.

The applicant for registration or reregistration of chlorsulfuron products subject to this Standard must comply with all terms and conditions described in this Standard and, when applicable, offer to pay compensation to the extent required by Sections 3(c)(1)(D) and 3(c)(2)(D) of FIFRA, as amended, 7 U.S.C. 136 (c)(1)(D) and 136 (c)(2)(D).

A. Manufacturing-Use Chlorsulfuron

1) Product Composition Standards

To be covered under this Standard, manufacturing-use chlorsulfuron products must contain chlorsulfuron as the sole active ingredient. In addition, the active ingredient found in the manufacturing-use chlorsulfuron products must not contain impurities other than those in the technical chlorsulfuron found in currently registered products. Further, these impurities should not be in higher concentration than those in the technical chlorsulfuron used in currently registered products. Any manufacturing-use product not meeting these requirements will be considered a new product and will not be registrable under this Standard.

Manufacturing-use products meeting these requirements may contain any percentage active ingredient.

2) Acute Toxicity Limits

The Agency will consider registration of manufacturing-use chlorsulfuron products in the following categories:

	I	II	III	IV
Acute Oral Toxicity	yes	yes	yes	yes
Acute Dermal Toxicity	yes	yes	yes	yes
Acute Inhalation Toxicity	yes	yes	yes	yes
Primary Eye Irritation	yes	yes	yes	yes
Primary Dermal Irritation	yes	yes	yes	yes

3) Use Patterns

To be covered under this Standard, manufacturing-use chlorsulfuron must be labeled for formulation into end-use herbicides which are intended for non-domestic, outdoor uses.

B. End-Use Chlorsulfuron - Water-Dispersible Granules

1) Product Composition Standards

To be covered under this Standard, end-use chlorsulfuron products must contain up to 75% chlorsulfuron as active ingredient. In addition, all end-use chlorsulfuron products must not contain inerts and impurities other than those in currently registered end-use products and at no higher concentration than those in currently registered end-use products. Inert ingredients must be exempted from the requirement of a tolerance (or have tolerances established) under 40 CFR 180.1001. Any end-use product not meeting these requirements wil be considered a new product and will not be registrable under this Standard.

2) Acute Toxicity Limits

The Agency will consider registration of any end-use chlorsulfuron products in the following categories:

	I	II	III	IV
Acute Oral Toxicity	yes	yes	yes	yes
Acute Dermal Toxicity	yes	yes	yes	yes
Acute Inhalation Toxicity	yes	yes	yes	yes
Primary Eye Irritation	yes	yes	yes	yes
Primary Dermal Irritation	yes	yes	yes	yes

3) Use Patterns and Application Methods

To be registered under this Standard, end-use chlorsulfuron products must be labeled for general use as herbicides for one or more of the following food crop uses: barley, oats, wheat, and reduced-tillage fallow systems to be followed by wheat. Application rates and methods for chlorsulfuron products must conform to those discussed in Chapter V.

Chlorsulfuron is manufactured and formulated by E. I. du Pont de Nemours & Company. One formulation, Glean™ Weed Killer, is manufactured as a 75% dry flowable formulation.

Glean™ Weed Killer will be used as a broadcast application in spray volumes of 1 to 20 gpa. Approximately half of the Glean used is expected to be applied by air in 1 to 5 gpa. Most applications will be made postemergence to the crop and weeds during the months of March through early June and October-December; however, some preemergence use on wheat and oats is anticipated in both the fall and spring. Except for spring (in crop prior to fallow) treatments, most applications for fallow weed control will be made after the cereal crop is harvested, and only on land schedules to be replanted to a cereal grain in the next cropping cycle. The maximum amount of chlorsulfuron which can be used in a 12-month period would be 1/2 ounce ai per acre on the crop and a follow-up treatment of 1/2 ounce ai per acre after harvest for weed control during the fallow period. (See Table I.)

Wheat is expected to be the major crop Glean™ Weed Killer will be used on, followed in order by fallow, barley, and oats. Future use on rye and flax is expected to be relatively small as these are minor crops.

Table I

Approved Application Rates of Chlorsulfuron

Formulation	Site	Type of Application	Ounce ai Per Acre
75% Dry Flowable	Wheat	Broadcast pre- and/or postemergence	up to 1/2
	Barley, Oats	Postemergence broadcast	up to 1/2
	Fallow	Broadcast post-harvest soil treatment	up to 1/2

Required Labeling

All chlorsulfuron products must bear labeling as specified in 40 CFR 162.10 and as described elsewhere in this guidance package. There are no unique labeling requirements for chlorsulfuron.

All manufacturing-use products must list on the label the intended end-use of formulated products produced from the manufacturing-use products. In accordance with data to be submitted or cited, all chlorsulfuron manufacturing-use product labels must bear the following statement.

> For Formulation into End-Use Herbicide Products Intended Only for Nondomestic, Outdoors Use.

Tolerance Assessment

U.S. tolerances have been established for residues of chlorsulfuron, 2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benzenesulfonamide, and its metabolite, 2-chloro-5-hydroxy-N[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl)benzenesulfonamide, in or on the following raw agricultural commodities:

20.0 ppm	barley, oats, and wheat; forage
0.5 ppm	barley, oats, and wheat; straw
0.1 ppm	barley, oats, and wheat; grain

U.S. tolerances have been established for residues of chlorsulfuron, 2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benzenesulfonamide, in or on the following raw agricultural commodities:

0.1 ppm	milk
0.3 ppm	meat, fat, and meat by-products of cattle, goats, hogs, horses, and sheep

The theoretical maximum residue contribution (TMRC) of total chlorsulfuron in the average American adult diet of raw agricultural commodities containing the respective U.S. tolerance levels is calculated to be 0.108 mg/day/1.5 kg. The Agency has established an acceptable daily intake (ADI) value of 0.05 milligrams of chlorsulfuron per kilogram of body weight per day. This value is based on a "no-observed-effect" level (NOEL) of 100 ppm established in a two-year rat feeding study, and the incorporation of a 100-fold safety factor in translating the data from animal to man. Assuming the average adult weighs 60 kg, the maximum permissible intake of chlorsulfuron, based on the 0.05 mg/kg estimate, is 3 mg/day or 0.0018 mg/kg per 60 kg person.

III

SUMMARY OF DATA REQUIREMENTS AND DATA GAPS

Applicants for registration of chlorsulfuron products must cite or submit the informtion identified as required in the tables in this chapter. The tables indicate whether the material to be tested is the technical grade or a formulation.

The tables list the Proposed Guidelines paragraph which describes the type of data and when the data are required to be submitted [43 FR, No. 132, 29696 of July 10, 1978; and 43 FR, No. 163, 37336 of August 22, 1978]. Justification as to why the test is required is provided in the Guidelines. A discussion of why data normally required are not necessary for this chemical is provided in footnotes to the tables. The data requirements specified are the minimum that will be required. Areas where additional data may be required as the result of tiered testing are indicated.

Table A-1

Product Chemistry

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-3	Product Identity and Disclosure Ingredients	yes	Technical grade of the active ingredient (TGAI)	yes	0113-0002, 0113-0003	no
163.61-4	Description of Manufacturing Process	yes	TGAI	yes	0113-0005	no
163.61-5	Discussion on Formation of Unintentional Ingredients	yes	TGAI	yes	0113-0005	no
163.61-6	Declaration and Certification of Ingredients Limits	yes	TGAI	yes	0113-0003	no
163.61-7	Product Analytical Methods and Data	yes	TGAI	yes	0113-0001, 0113-0003	
163.61-8(1)	Color	yes	TGAI	yes	0113-0007	no
163.61-8(2)	Odor	yes	TGAI	yes	0113-0007	no
163.61-8(3)	Melting Point	yes	TGAI	yes	0113-0007	no

Table A-1 (Cont'd)

Product Chemistry

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-8(4)	Solubility	yes	Technical grade of the active ingredient (TGAI)	yes	0113-0007, 0113-0008	no
163.61-8(5)	Stability	yes	TGAI	yes	0113-0007	no
163.61-8(6)	Octanol/Water Partition Coefficient	yes	TGAI	yes	0113-0007, 0113-0008	no
163.61-8(7)	Physical State	yes	TGAI	yes	0113-0007	no
163.61-8(8)	Density or Specific Gravity	yes	TGAI	yes	0113-0007	no
163.61-8(9)	Boiling Point	no				
163.61-8(10)	Vapor Pressure	yes	TGAI	yes	0113-0007	no
163.61-8(11)	pH	yes	TGAI	yes	0113-0007	no
163.61-8(12)	Storage Stability	no				

Table A-1 (Cont'd)

Product Chemistry

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-8(13)	Flammability	no				
163.61-8(14)	Oxidizing or Reducing Action	no				
163.61-8(15)	Explosiveness	no				
163.61-8(16)	Miscibility	no				
163.61-8(17)	Viscosity Coefficient	no				
163.61-8(18)	Corrosion Characteristics	no				
163.61-8(19)	Dielectric Breakdown Voltage	no				
163.61-9	Submittal of Samples	yes		yes		no

Table A-2

Environmental Fate

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.62-7(b)	Hydrolysis	yes	Pure Active Ingredient, Radiolabeled (PAIRA/TGAI)	yes	0113-0014, 0113-0017	no
163.62-7(c)	Photodegradation	yes	PAIRA/TGAI	yes	0113-0014, 0113-0019	no
163.62-8(b)	Aerobic Soil Metabolism	yes	PAIRA/TGAI	yes	0113-0013, 0113-0024	no
163.62-8(c)	Anaerobic Soil Metabolism	yes	PAIRA/TGAI	yes	0113-0010	no
163.62-8(e)	Aerobic Aquatic Metabolism	no				
163.62-8(f)	Microbial Metabolism:					
	(1) Effects of Microbes on Pesticides	no				
	(2) Effects of Pesticides on Microbes	no				

Table A-2 (Cont'd)

Environmental Fate

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.62-8(g)	Activated Sludge	no				
163.62-9(b)	Leaching	yes	Technical grade of the active ingredient (TGAI)	yes	0113-0008, 0113-0009, 0113-0011	no
163.62-9(c)	Volatility	no				
163.62-9(d)	Adsorption/ Desorption	no				
163.62-9(e)	Water Dispersal	no				
163.62-10(b)	Terrestrial Field Dissipation:					
	(1) Field & Vegetable Crops	yes	A representative formulation	yes	0113-0015, 0113-0016	no
	(2) Tree Fruit & Nut Crops Uses	no				
	(3) Pasture Land Uses	no				
	(4) Domestic Outdoor Parks, Ornamental & Turf Uses	no				
	(5) Rights-of-Way, Shelterbelts & Related Uses	no				

Table A-2 (Cont'd)

Environmental Fate

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.62-10(c)	Aquatic Field Dissipation:	no				
	(1) Aquatic Food Crop Uses	no				
	(2) Aquatic Noncrop Uses	no				
	(3) Specialized Aquatic Uses	no				
163.62-10(d)	Terrestrial/Aquatic (Forest) Field Dissipation	no				
163.62-10(e)	Aquatic Impacts Uses:					
	(1) Direct Discharge	no				
	(2) Indirect Discharge	no				
	(3) Waste Water Treatment	no				
163.6-20- 2-10(f)	Combination & Tank Mix Field Dissipation	no				
163.62-10(g)	Long-Term Field Dissipation Study	no				

Table A-2 (Cont'd)

Environmental Fate

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.62-11(b)	Accumulation in Rotational Crops	yes	PAIRA/Representative Formulation	yes	0113-0018, 0113-0025	no
163.62-11(c)	Accumulation in Irrigated Crops	no				
163.62-11(d)	Fish Accumulation	yes	PAIRA/TGAI	yes	0113-0020, 0113-0021	no
163.62-11(e)	Special Studies Accumulation in Aquatic Noncrop	no				
163.62-13	Disposal & Storage	no				

Table A-4

Toxicology

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.81-1	Acute Oral Toxicity	yes	Technical grade of the active ingredient (TGAI)	yes	0113-0048	no
163.81-2	Acute Dermal Toxicity	yes	TGAI	yes	0113-0028	no
163.81-3	Acute Inhalation Toxicity	yes	TGAI	yes	0113-0029	no
163.81-4	Primary Eye Irritation	no				
163.81-5	Primary Dermal Irritation	yes	TGAI	yes	0113-0032	no
163.81-6	Dermal Sensitization	yes	TGAI	yes[1]/	0113-0032	no
163.81-7	Acute Delayed Neurotoxicity	no				

[1]/Data are available for the end-use product. If a technical product is registered, then additional data will be required.

Table A-4 (Cont'd)

Toxicology

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.82-1	Subchronic Oral Toxicity	yes	TGAI	yes	0113-0034, 0113-0041, 0113-0046, 0113-0050	no
163.82-2	Subchronic (21-day) Dermal	no				
163.82-3	Subchronic 90-day Dermal Toxicity	no				
163.82-4	Subchronic Inhalation Toxicity					
163.82-5	Subchronic Neurotoxicity	no				

Table A-4 (Cont'd)

Toxicology

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.83-1	Chronic Feeding (rat and dog)	yes	Technical grade of the active ingredient (TGAI)	yes	0113-0041, 0113-0052	no
163.83-2	Oncogenicity (rat and mouse)	yes	TGAI	yes	0113-0051, 0113-0052	no
163.83-3	Teratogenicity	yes	TGAI	yes	0113-0037, 0113-0039	no
163.83-4	Reproduction	yes	TGAI	yes	0113-0052	no
163.84-(2-4)	Mutagenicity	yes	TGAI	yes[1/]	0113-0031, 0113-0040, 0113-0049	no
163.85-1	Metabolism	yes	PAIRA	yes	0113-0038, 0113-0042	no
163.86-1	Domestic Animal Safety Testing	no				

[1/] Data requirements for mutagenicity have not yet been finalized. No additional data are required at this time.

Table A-5

Residue Chemistry

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
-	Metabolism in Plants	yes	PAIRA	yes[2]/	0113-0055 0113-0056	no
-	Metabolism in Animals	yes	PAIRA	yes[2]/	0113-0038, 0113-0042, 0113-0054, 0113-0057	no
-	Analytical Methods	yes	Typical End-use Product (TEP)	yes[2]/	0113-0058, 0113-0060	no
-	Residue Data: Crops	yes	TEP	yes[3]/	0113-0053	no
-	Residue Data: Processed Crops	no				
-	Residue Data: Milk & Meat & Eggs	yes[1]/	TEP	yes[2]/	0113-0059	no
-	Storage and Stability	no				

1/Residue data are required for milk and meat only.
2/Available data support tolerances for wheat, barley, oats, and fallow uses. Additional data may be required if tolerances are sought for other crops or for uses at rates and frequencies not indicated in Chapter II.
3/Additional data will be required for each crop for which new tolerances are sought.

Table A-3

Ecological Effects

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.71-1	Avian Single Dose Oral LD_{50}	yes	Technical grade of the active ingredient (TGAI)	yes	0113-0062, 0113-0068	no
163.71-2	Avian Dietary LC_{50}	yes	TGAI	yes	0113-0061, 0113-0069	no
163.71-3	Mammalian Acute Toxicity	no				
163.71-4	Avian Reproduction	no				
163.71-5	Simul. & Actual Field Testing for Mammals/Birds	no				

Table A-3 (Cont'd)

Ecological Effects

Generic Data Requirements

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.72-1	Fish Acute LC_{50}	yes	Technical grade of the active ingredient	yes	0113-0064, 0113-0065, 0113-0066, 0113-0067	no
163.72-2	Acute Toxicity to Aquatic Invertebrates	yes	Technical grade of the active ingredient	yes	0113-0063	no
163.72-3	Acute Toxicity to Estuarine & Marine Organisms	no				
163.72-4	Embryolarvae & Life-Cycle	no				
163.72-5	Aquatic Organ. Tox. & Residue Studies	no				
163.72-6	Simul. & Actual Field Testing for Aquatic Organisms	no				

Table B-1

Product Chemistry

Product-Specific Data Requirements for Manufacturing-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-3	Product Identity and Disclosure of Ingredients	yes	Each product	No		yes[1]/
163.61-4	Description of Manufacturing/ Formulating Process	yes	Each product	No		yes[1]/
163.61-5	Discussion on Formation of Unintentional Ingredients	yes	Each product	No		yes[1]/
163.61-6	Declaration and Certification of Ingredients Limits	yes	Each product	No		yes[1]/
163.61-7	Product Analytical Methods and Data	yes	Each product	No		yes[1]/
163.61-8(1)	Color	yes				yes[1]/
163.61-8(2)	Odor	yes				yes[1]/
163.61-8(3)	Melting Point	no				

Table B-1 (Cont'd)

Product Chemistry

Product-Specific Data Requirements for Manufacturing-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-8(4)	Solubility	no				
163.61-8(5)	Stability	no				
163.61-8(6)	Octanol/Water Partition Coefficient	no				
163.61-8(7)	Physical State	yes	Each product	no		yes[1]/
163.61-8(8)	Density or Specific Gravity	yes	Each product	no		yes[1]/
163.61-8(9)	Boiling Point	yes	Each product	no		yes[1]/
163.61-8(10)	Vapor Pressure	yes	Each product	no		yes[1]/
163.61-8(11)	pH	yes	Each product	no		yes[1]/
163.61-8(12)	Storage and Stability	yes	Each product	no		yes[1]/

Table B-1 (Cont'd)

Product Chemistry

Product-Specific Data Requirements for Manufacturing-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-8(13)	Flammability	yes	Each product	no		yes[1]/
163.61-8(14)	Oxidizing or Reducing Action	yes	Each product	no		yes[1]/
163.61-8(15)	Explosiveness	yes	Each product	no		yes[1]/
163.61-8(16)	Miscibility	yes	Each product	no		yes[1]/
163.61-8(17)	Viscosity Coefficient	yes	Each product	no		yes[1]/
163.61-8(18)	Corrosion Characteristics	yes	Each product	no		yes[1]/
163.61-8(19)	Dielectric Breakdown Voltage	no				
163.61-9	Submittal of Samples	no				

Footnotes

Table B-1

Product Chemistry

Product-Specific Chemistry Data Requirements for

Manufacturing-Use Products

Chlorsulfuron

1/ Currently there are no MUP registration applications. The data gaps indicated in these tables will apply when an application is submitted.

Table B-2

Toxicology

Product-Specific Data Requirements for Manufacturing-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.81-1	Acute Oral Toxicity	yes	Each product	no		yes[1]/
163.81-2	Acute Dermal Toxicity	yes	Each product	no		yes[1]/
163.81-3	Acute Inhalation Toxicity	yes	Each product	no		yes[1]/
163.81-4	Primary Eye Irritation	yes	Each product	no		yes[1]/
163.81-5	Primary Dermal Irritation	yes	Each product	no		yes[1]
163.81-6	Dermal Sensitization	yes	Each product	no		yes[1]/

1/ Currently there are no MUP registration applications. The data gaps indicated will apply when an application is submitted. Depending on the product, data available on the technical product may be used.

Table C-1

Product Chemistry

Product-Specific Data Requirements for End-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy[5]/ this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-3	Product Identity and Disclosure of Ingredients	yes	Each product	partial[1]/	0113-0003, 0113-0004	yes[1]/
163.61-4	Description of Manufacturing/ Formulating Process	yes	Each product	partial[2]/	0113-0005	yes[2]/
163.61-5	Discussion on Formation of Unintentional Ingredients	yes	Each product	yes	0113-0005	no
163.61-6	Declaration and Certification of Ingredients Limits	yes	Each product	partial[4]/	0113-0003, 0113-0004	yes[4]/
163.61-7	Product Analytical Methods and Data	yes	Each product	partial[3]/	0113-0001	yes[3]/
163.61-8(1)	Color	yes	Each product	yes	0113-0007	no
163.61-8(2)	Odor	yes	Each product	yes	0113-0007	no

Table C-1 (Cont'd)

Product Chemistry

Product-Specific Data Requirements for End-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy[5]/ this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-8(3)	Melting Point	no				
163.61-8(4)	Solubility	no				
163.61-8(5)	Stability	no				
163.61-8(6)	Octanol/Water Partition Coefficient	no				
163.61-8(7)	Physical State	yes	Each product	yes	0113-0007	no
163.61-8(8)	Density or Specific Gravity	yes	Each product	yes	0113-0007	no
163.61-8(9)	Boiling Point	no				
163.61-8(10)	Vapor Pressure	yes	Each product	yes	0113-0007	no
163.61-8(11)	pH	yes	Each product	yes	0113-0007	no
163.61-8(12)	Storage Stability	yes	Each product	yes	0113-0006	no

Table C-1 (Cont'd)

Product Chemistry

Product-Specific Data Requirements for End-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy[5]/ this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.61-8(13)	Flammability	yes	Each product	yes	0113-0007	no
163.61-8(14)	Oxidizing or Reducing Action	yes	Each product	yes	0113-0007	no
163.61-8(15)	Explosiveness	yes	Each product	yes	0113-0007	no
163.61-8(16)	Miscibility	yes	Each product	yes	0113-0007	no
163.61-8(17)	Viscosity Coefficient	yes	Each product	yes	0113-0007	no
163.61-8(18)	Corrosion Characteristics	yes	Each product	yes	0113-0007	no
163.61-8(19)	Dielectric Break-down Voltage	no				
163.61-9	Submittal of Samples	yes		yes	N/A	no

Footnotes

Table C-1

Product Chemistry

Product-Specific Chemistry Data Requirements for

End-Use Products

Chlorsulfuron

1/ Chemical Abstract Registry numbers are needed for the related compounds of chlorsulfuron and the intentional inerts listed in the Confidential Statement of Composition.

2/ Information on the formulating process for the marketed product and on the steps taken to assure a uniform product are required.

3/ Composition data, determined on five or more samples which are representative of the commercial product, need to be submitted.

4/ For each product tested under Section 163.61-7, provide for chlorsulfuron both upper and lower composition limits; and for any potentially hazardous impurity (e.g. nitrosamine or other impurities associated with the manufacture of chlorsulfuron) an upper limit. Methodologies are not required for other certified ingredients, inerts, or impurities ($\geq$0.1%).

5/ Data requirements listed are for currently registered products. Applicants seeking registration of other products should consult Part 158 Guidelines or consult EPA for product-specific data requirements.

Table C-2

Toxicology

Product-Specific Data Requirements for End-Use Products

Chlorsulfuron

Guidelines Citation	Name of Test	Are Data Required For This Standard?	Composition	Does EPA Have Data to Partially or Totally Satisfy[1]/ this Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)?
163.81-1	Acute Oral Toxicity	yes	Each product	yes	0113-0036	no
163.81-2	Acute Dermal Toxicity	yes	Each product	yes	0113-0026	no
163.81-3	Acute Inhalation Toxicity	yes	Each product	yes	N/A	no
163.81-4	Primary Eye Irritation	yes	Each product	yes	0113-0043	no
163.81-5	Primary Dermal Irritation	yes	Each product	yes	0113-0044, 0113-0045	no
163.81-6	Dermal Sensitization	yes	Each product	yes	0113-0044	no

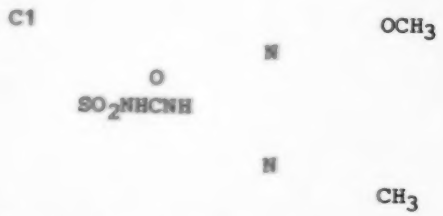
1/ Data requirements listed are for currently registered products. Applicants seeking registration of other products should consult Part 158 Guidelines or consult EPA for product-specific data requirements.

IV

PRODUCT CHEMISTRY

Product Chemistry Summary - Technical Chlorsulfuron

Chlorsulfuron is synthesized by reacting 2-chlorobenzenesulfonamide with n-butyl isocyanate and phosgene in a suitable solvent, followed by treatment of the resulting 2-chlorobenzenesulfonyl isocyanate with 4-methoxy-6-methyl-1,3,5-triazin-2-amine (Du Pont 1981d, MRID #0113-0005). In addition, confidential data describing the chlorsulfuron manufacturing process and impurities found in the technical (Du Pont 1981a, b, and d, MRID #'s 0113-00002, 0113-0003, and 0113-0005) have been reviewed by the Agency. Each registrant must provide a discussion of the manufacturing process and an estimate of the amount of any unintended substances which are formed. The molecular structure of chlorsulfuron is:



The Agency has reviewed the reversed-phase, high performance liquid chromatography method (Du Pont 1980, MRID #0113-0001) and found it adequate for the identification and quantification of chlorsulfuron in the technical, manufacturing-use, and end-use products.

Physical and Chemical Properties

Data on purified chlorsulfuron are as follows (Du Pont 1981f, MRID #0113-0007):

Color:	white
Odor:	none
Melting Point:	174-178°C
Solubility:	The solubilities of purified chlorsulfuron in selected solvents at 22°C are as follows: <10 ppm in hexane, 0.3% in toluene, 1.8% in methanol, 7.0% in acetone, 7.7% in methylene chloride,and 100 to 125 ppm in water (Rapisarda et al. 1981, MRID #0113-0008).
Stability:	Stable under normal use conditions, hydrolyzes slowly under acidic conditions.
Octanol/Water Partition Coefficient:	K_{ow}=13 Rapisarda et al. 1981, MRID #0113-0008).

Physical State:	crystalline solid
Density:	bulk density is 30 to 36 lb/ft^3, absolute density is 1.52 g/cc
Vapor Pressure:	4.6×10^{-6} mm Hg at 25°C
pH:	4.10 at 25°C (saturated solution)

Summary of Major Data Gaps

There are no data gaps in Product Chemistry.

V

ENVIRONMENTAL FATE

Use Profile

Chlorsulfuron is a herbicide used for the control of many common broadleaf weeds and certain grassy weeds in the cereal crops of wheat, barley, and oats. In addition, chlorsulfuron will be used to control weeds during the fallow period, prior to the planting of wheat. Chlorsulfuron also has selectivity on rye and flax. Future use on these crops is anticipated, but is not covered by this Standard.

Chlorsulfuron is manufactured and formulated by E.I. du Pont de Nemours & Company. One formulation, Glean™ Weed Killer, is manufactured as a 75% dry flowable formulation.

Glean™ Weed Killer will be used as a broadcast application in spray volumes of 1 to 20 gpa. Approximately half of the "Glean" used is expected to be applied by air in 1 to 5 gpa and the rest by ground rigs. Most applications will be made postemergence to the crop and weeds during the months of March through early June and October/December; however, some preemergence use on wheat and oats is anticipated in both the fall and spring. Except for spring (in crop prior to fallow) treatments, most applications for fallow weed control will be made after the cereal crop is harvested, and only on land scheduled to be replanted to a cereal grain in the next cropping cycle. The maximum amount of chlorsulfuron which can be used in a 12-month period would be 1/2 ounce ai per acre on the crop and a follow-up treatment of 1/2 ounce ai per acre after harvest for weed control during the fallow period. (See Table I.)

Wheat is expected to be the major crop Glean™ Weed Killer will be used on, followed in order by fallow, barley, and oats. Future use on rye and flax is expected to be relatively small as these are minor crops.

Table I

Approved Application Rates of Chlorsulfuron

Formulation	Site	Type of Application	Ounce ai Per Acre
75% Dry Flowable	Wheat	Broadcast pre- and/or postemergence	up to 1/2
	Barley Oats	Postemergence broadcast	up to 1/2
	Fallow	Broadcast post-harvest soil treatment	up to 1/2

Environmental Fate Summary

Degradation

At pH 7 and 9, chlorsulfuron undergoes less than 5% hydrolysis after 28 days at 10° and 20°C. At pH 4, chlorsulfuron hydrolyzes with a half-life of one to two weeks (Han 1980b, MRID #0113-0014 and Han 1981b, MRID #0113-0017). Chlorsulfuron degrades in aqueous solution under artificial sunlight (90% degradation after 4 weeks). Under natural sunlight, the half-life of chlorsulfuron was less than 2 weeks in distilled water, and between 4 and 8 weeks in natural creek water. When exposed to artificial sunlight as a dry film on glass, chlorsulfuron did not appreciably degrade or volatilize (<5% over 4 weeks) (Han 1980b, MRID #0113-0014). When chlorsulfuron was applied to soil and then exposed to artificial sunlight, its half-life was between 2 and 3 weeks (Han 1981d, MRID #0113-0019).

Metabolism

Aerobic soil metabolism studies with chlorsulfuron showed a half-life of between 1 and 2 months for two soils (Han 1980a, MRID #0113-0013). A soil biometer study showed that the major route for degradation of chlorsulfuron is cleavage of the urea bridge accompanied by microbial degradation of the cleavage products. The half-life of chlorsulfuron was between one and two weeks when incubated at 25°C in the dark. The microbial degradation was shown to be temperature and moisture sensitive (Rapisarda 1981a, MRID #0113-0024).

In a soil biometer study, chlorsulfuron had minimal effect on the ability of soil microorganisms to degrade protein and cellulose (Rapisarda 1981a, MRID #0113-0024). Studies show that chlorsulfuron is not fungicidal or bactericidal since it did not affect the growth of typical soil microorganisms, including soil-nitrifying bacteria (Julis 1980, MRID #0113-0023 and Han and Smith 1980, MRID #0113-C022).

An anaerobic aquatic metabolism study showed that chlorsulfuron is only very slowly, if at all, degraded by anaerobic hydrosoil microorganisms. Under anaerobic conditions, the rate of chlorsulfuron degradation is consistent with a slow pH-dependent hydrolysis (Chrzanowski 1981a, MRID #0112-0010).

Mobility

The soil K-value (Freundlich isotherm constant) for chlorsulfuron at 25°C were 0.42 for Keyport silt loam (2.75% om) and 0.69 for Flanagan silt loam (4.0% om). The soil TLC (R_f) values were 0.87 and 0.66 for the same soils. These results show that chlorsulfuron is mobile (mobility class 4) (Rapisarda *et al.* 1981, MRID #0113-0008).

In a soil leaching study, chlorsulfuron was mobile in samples of sand (2.4% om), sandy loam (1.4% om), silty clay loam (4.0% om), and silt loam (2.75% om). In fresh samples from 76 to 80% of the parent moved into the leachate but in aged samples only from 20 to 33 percent reached the leachate.

In aged samples, 43 to 88 percent of the residues were retained in the top 12 inches of the soil column, 43 percent in the sand (2.4% om) and 88 percent in the sandy loam (1.4% om). From 3 to 6 ppb reached the 20-inch depth in the sandy loam soil, but up to 12 ppb reached the 20-inch depth in the sandy soil. The data indicate that chlorsulfuron is resistant to decomposition in anaerobic aquatic environments.

In well-drained soil, there is a potential for trace groundwater contamination. Because of low correlation between soil type and mobility, it appears that there is a strong tendency for chlorsulfuron to leach in all permeable soil types. However, because of the low use rates for chlorsulfuron and the fact that residues are dispersed as they leach into deeper soil layers, significant ground water accumulation may not occur.

Dissipation

Under field conditions at 5 sites, the half-life of chlorsulfuron on slightly acidic soils (pH 5.6 to 6.7) was about 1 month. On an alkaline soil (pH 7.3), the half-life was 2 to 3 months. Chlorsulfuron moves downward with rainfall but more chlorsulfuron remained in the top 4 inches of soil than in the combined next 11 inches of soil after 18 months (Han 1980c and 1981a, MRID #0113-0015 and #0113-0016).

Accumulation

In both greenhouse and field studies, rotational crops (soybeans, rape, wheat, sugar beets), which were grown on soil containing traces of residual chlorsulfuron and/or its soil metabolites, did not accumulate significant levels of residues. In all crops, no chlorsulfuron (<1 ppb) was detected (Han 1981c, MRID #0113-0018 and Rapisarda 1981b, MRID #0113-0025). In a dynamic accumulation study on bluegill sunfish, there was little or no residue accumulation in edible tissue (accumulation factor <1), liver (1 to 21), or viscera (1 to 10) at either 0.01 or 1.0 ppm (Han 1981e, MRID 0113-0020). Similarly, in a static accumulation study with channel catfish, there was no residue accumulation in the viscera (12), liver (7), and edible tissue (1.5) (Han 1981f, MRID #0113-0021).

Drift

Two aerial spray drift studies showed that estimated residues of chlorsulfuron from drift at 15 meters downwind were 0.03% of the original 1 ounce active ingredient/acre. Thirty meters downwind, residues were not detectable. These studies also indicated that, under favorable wind conditions, sensitive crops 50 to 70 meters downwind should not be threatened (Du Pont 1981g, MRID #011300012).

Exposure Profile

There is minimal exposure of humans and wildlife to chlorsulfuron. Mixers and applicators of chlorsulfuron formulations are at risk of the highest direct exposures. Dermal and eye exposure can result from splashing during handling or mixing. Since the dry flowable formulation is not dusty and since use rates are on the order of 30 to 100 times lower than

typical use rates for other commonly used herbicides, the extent of exposure to mixers and loaders is minimized. In addition, respiratory exposure is limited due to the large particle size of the dry flowable formulation and the low vapor pressure of chlorsulfuron. The general public has little or no dietary exposure to chlorsulfuron and its metabolites. Domestic animals are exposed to residues of chlorsulfuron and its metabolites if they are grazed on wheat treated with chlorsulfuron. See Chapter VII, Residue Chemistry, for a discussion of dietary exposure to chlorsulfuron.

Summary of Major Data Gaps

There are no data gaps for Environmental Fate.

VI

TOXICOLOGY

Toxicology Summary - Technical Chlorsulfuron

Acute Toxicity

The acute oral LD_{50} of technical chlorsulfuron is 5545 mg/kg in male rats and 6293 mg/kg in female rats (Trivits 1979, MRID #0113-0048), suggesting a very low acute oral hazard to human beings. Studies were conducted using a single intragastric dose as a corn oil suspension with gross pathology after 14 days. Clinical signs included weight loss, humped posture, lethargy, salivation, diarrhea, and hematuria. Gross pathological changes were noted in liver, spleen, kidney, gastrointestinal tract, thymus, lungs, brain, heart, eye, pancreas, testis, skin, uterus, and stomach.

Technical chlorsulfuron has a low potential for acute dermal hazard to humans, since the acute dermal LD_{50} in male and female rabbits is >3400 mg/kg (Edwards 1979, MRID #0113-0028). Application was by single dose with saline to abraded skin, occluded, and 24-hour contact. Only slight skin irritation was observed. No compound-related abnormalities were seen in gross pathology.

Based on a 4-hour exposure of 10 male and 10 female rats to a dust atmosphere of 5.9 mg technical chlorsulfuron/liter (LC_{50} >5.9 mg/1), a low acute inhalation hazard in human beings is expected (Ferenz 1980, MRID #0113-0039). No mortality was noted in this study. No unusual clinical signs were observed during the exposure. No compound-induced pathological findings were detected in any of the rats.

Chlorsulfuron is thus placed in Category III for acute dermal, and acute inhalation. It is placed in Category IV for acute oral, skin irritation, and skin sensitization hazards.

Subchronic Toxicity

Chlorsulfuron administered orally to male rats at 2200 mg/kg/day for 10 days over a 2-week period produced no compound-related gross or histological changes. Clinical signs noted were slight weight loss, stained fur, and weakness (Henry 1977, MRID #0113-0034). Two 90-day feeding studies at dietary levels of 0, 100, 500, and 2500 ppm for male and female rats and 0, 500, 2500, 5000, and 7500 ppm for male and female mice reported a NOEL of 100 ppm in the diet of rats (Wood 1980, MRID #0113-0050) and 2500 ppm in the diet of mice (Smith 1980, MRID #0113-0046). Clinical signs noted in the rats at 500 or 2500 ppm included decreased urine pH, plasma creatinine, monocyte counts, erythrocyte counts and increased hematocrits. Clinicals signs noted in the male mice at 5000 or 7500 ppm had were decreased erythrocyte counts and increased mean corpuscular volumes and mean corpuscular hemoglobins. Females fed 5000 or 7500 ppm had decreased neutrophilic granulocytes and increased lymphocytes. There were no gross pathological or histopathological compound-related lesions in either 90-day study.

Chronic Toxicity

Dietary administration of 0, 100, 500, and 2500 ppm chlorsulfuron to male and female young adult dogs for 6 months produced a NOEL of 2500 ppm in the diet (Schneider 1900, MRID #0113-0041). No compound-related changes in nutritional, clinical, biochemical, gross or histopathological observations were made.

Dietary administration of 0, 100, 500, and 2500 ppm chlorsulfuron to male and female weanling rats for 2 years produced a NOEL of 100 ppm in the diet (Wood 1981b, MRID #0113-0052). Chlorsulfuron produced a mild to moderate reduction in mean body weights and weight gains in male rats from the 500 and 2500 ppm groups. Dose-dependent hematological effects were observed during the first, but not the second year of the study in the 500 and 2500 ppm males. No other compound-related behavioral, nutritional, clinical, or pathological abnormalities were observed.

Oncogenicity studies were conducted with male and female mice by a dietary administration of 0, 100, 500, 5000 ppm chlorsulfuron for 2 years (Wood 1981a, MRID #0113-0051). No compound-related behavioral, clinical, hematological, gross pathological, or histological abnormalities were observed. Chlorsulfuron was not oncogenic at any level. The overall NOEL was 500 ppm as a body weight reduction occurred in the 5000 ppm level.

Chlorsulfuron was administered in the diets of female rats at 0, 100, 500, and 2500 ppm from day 6 through day 15 of gestation. Examination of uterine contents was on day 21 of gestation (Rogers and Culik 1978, MRID #0113-0039). Chlorsulfuron was not teratogenic or fetotoxic. No clinical signs of toxicity, changes in behavior, or gross pathological changes in organs or tissues were observed in the treated rats. Additionally, chlorsulfuron was adminstered to rabbits by oral intubation as a corn oil suspension of 0, 10, 25, and 75 mg/kg BW from day 6 through day 19 of gestation. Uterine contents were examined on day 29 of gestation. Chlorsulfuron was not teratogenic to rabbits dosed with up to 75 mg/kg. The incidence of resorptions in the high dose treatment group was significantly increased, indicating fetotoxicity. The NOEL for fetotoxicity was 25 mg/kg (Hoberman 1980, MRID #0113-0037).

A 3-generation rat production study was conducted with test animals maintained on dietary levels of 0, 100, 500, and 2500 ppm chlorsulfuron. Only slightly decreased fertility indices were noted in the 2500 ppm test group. No compound-related gross or histopathological abnormalities were observed in weanling rats from the F_{3b} litters. The NOEL was 500 ppm (Wood 1981b, MRID #0113-0052).

Mutagencity

In a Salmonella/microsome assay, chlorsulfuron was not mutagenic at up to 30 mg/plate (cytotoxic limit). Conditions included positive and solvent controls, presence and absence of an activation system (Russell 1977, MRID #0113-0040).

Chlorsulfuron was not cytotoxic or mutagenic at concentrations up to 2.8 mM in a Chinese hamster ovary cell assay (Waterer 1980, MRID #0113-0049).

Conditions included postitive and solvent controls, presence and absence of an activation system. Evaluations included cytotoxicity, mutants in treated sample compared to control and dose-response relationship.

In an in vitro cytogenetic assay in Chinese hamster ovary cells, chlorsulfuron did not induce aberrations at doses up to 5 mg/ml. The study was conducted both with and without metabolic activation (Galloway 1981, MRID #0113-0031).

Metabolism

In a metabolism study in rats (Shrivastava 1980, MRID #0113-0042 and Hunt 1981, MRID #0113-0038), chlorsulfuron was rapidly and quantitatively excreted. Neither chlorsulfuron nor its metabolites accumulate in organ or body tissues.

Toxicology Summary - Chlorsulfuron Fomulations

Data are available from acute toxicity studies on a 75% dry flowable formulation. The acute oral LD_{50} is 3053 mg/kg in male rats and 2341 mg/kg in female rats (Hinckle 1981, MRID #0113-0036). Studies were conducted using a single intragastric dose as a corn oil suspension with gross pathology after 14 days. Clinical signs included diarrhea, stained fur, lacrimation, lethargy, and moderate weight loss. Gross pathological changes were noted in lungs, thymus, brain, stomach, G.I. tract, liver, eyes, salivary lymph nodes, spleen, adrenals, and kidneys.

The acute dermal LD_{50} is greater than 2000 mg/kg in rabbits (Ashley 1980, MRID #0113-0026). Only slight skin irritation was observed. No compound-related abnormalities were seen in gross pathology.

In studies with rabbits, a single dose (0.1 ml) was placed in the conjunctival sac. After 20 seconds, three treated eyes were washed and six were left unwashed. Mild conjunctivitis and slight corneal cloudiness were noted. Transient slight iritic injection was seen in the unwashed eyes and persistent iritic swelling in one washed eye. All eyes, except the one washed eye, were normal within 4 days. The persistent iritic effect may be coincidental since it was not observed until the third day. (Silber 1980a, MRID #0113-0043).

When tested on intact and abraded skin of rabbits (single dose of 0.5 g with saline), the formulation was not a primary skin irritant (Silber 1980c, MRID #0113-0045). Skin irritation and sensitization was tested on guinea pigs with 60% and 6% suspensions. There was no skin irritation or sensitization during the primary test. Slight irritation and no sensitization occurred at 60% in both test and control animals at challenge. The formulation is neither a skin irritant nor a skin sensitizer on guinea pigs (Silber 1980b, MRID #0113-0044).

Results from these studies place the 75% dry flowable formulation in Toxicity Category III for acute oral, acute dermal, eye irritation, and dermal irritation and sensitization hazards.

Summary of Major Data Gaps

There are no data gaps in Toxicology.

VII

RESIDUE CHEMISTRY

Formulation

The formulation requested for use is DuPont's Glean Weed Killer. Glean contains 79.8% of technical chlorsulfuron. All inerts in the formulation are cleared under Section 180.1001.

Technical chlorsulfuron is a minimum of 94% pure. The manufacturing process and impurities are detailed in (EPA Accession No. 070471) PP# 2F2604. We expect no additional residue problems with the small amounts of impurities in the formulation.

Proposed Use

To control weeds in wheat, oats and barley, apply chlorsulfuron post-emergence and/or pre-emergence (wheat only) at rates of 3.54 to 14.18 grams active ingredient/acre. The herbicide can be applied via ground or aerial equipment using a minimum of 3 or 1 gallons of solution per acre respectively.

Tank mixtures with diuron and metribuzin for use on winter wheat are recommended. The directions for the tank mixes should include a statement which explains that all restrictions on the diuron and metribuzin labels must be observed.

DuPont surfactant WK or Ortho X-77 surfactants are recommended for postemergence treatments.

Metabolism

Plants

Metabolism studies on wheat and barley grown both in the field and in a greenhouse were submitted. (See PP#2F2604/EPA Accession No. 070471).

The wheat experiments involved treating flats of wheat in the four-leaf stage with ^{14}C-phenyl-labeled chlorsulfuron at a rate of 70 g/ha. Wheat samples were collected at 1 day, 1, 2, and 4 weeks after treatment and at maturity. Treated leaves and new growth were analyzed separately. The samples were washed with acetone to remove surface residues, blended with 80:20 acetone/water, centrifuged and the supernatant removed. The acetone was stripped off and the concentrated solution was acidified and extracted first with ether and then with N-butyl alcohol. The ether and alcohol solutions were taken to dryness.

The various fractions contained the following radoactive residues. The intitial acetone fraction contained surface residues of chlorsulfuron and hydrolysis products. The other extract contained parent, hydrolysis products and a conjugate. The N-butyl alcohol fraction contained mainly a conjugate of chlorsulfuron. The remaining water extract showed highly polar materials.

The conjugate in the N-butyl alcohol extract was isolated via TLC and hydrolyzed with beta-glucosidase in phosphate buffer at 34°C for 4 hours. This was followed by acidification and ether extraction. Ether extracts were purified via TLC and counted and isolated materials were further identified using mass spectrometry.

The results of the greenhouse study showed that radioactive residues in wheat forage decreased from 1.51 ppm at day 1 to 0.045 ppm at maturity. Wheat grain contained only 0.0072 ppm of radioactivity. Very little translocation to new growth of wheat forage was observed. Radioactivity in the foliage consisted of chlorsulfuron and 2-chlorobenzenesulfonamide. Radioactivity released upon hydrolysis with beta-glucosidase was identified as 2-chloro-5-hydroxy-N-[(4-methoxy-6-methyl-1,3,5-triazine-2-yl) aminocarbonyl] benezenesulfonamide. This chemical was most probably conjugated with glucose since the enzyme employed is highly specific for cleavage of glucose conjugates.

Wheat plants were also treated with ^{14}C-phenyl-labeled chlorsulfuron in a field situation. The treatment rate was 100 g/ha and application was made when plants were about 12 inches high. Samples were taken daily for six days and at 2 weeks, 1 month and 2 months (maturity). The samples were extracted and handled as described above for the greenhouse samples.

Radioactivity in the wheat plants ranged from 0.38 to 10.8 ppm (dry weight basis) during the experiment. Again very little translocation to the new growth of the plants was observed. The grain contained ca 0.03 ppm of radioactive residue. The radioactivity was identified as parent compound along with two conjugated metabolites. Parent compound accounted for 26% of the total radioactivity initially but this decreased to 5% at maturity. Metabolite A made up 57% of the total radioactivity at Day 1. Metabolite B comprised 5% of the radioactive residue on the first day. As the experiment continued the percentage of A decreased to ca 28% with the amount of B correspondingly increasing to 30%. In all, 60 to 90% of the total radioactive residue was identified depending on the length of time between treatment and sampling. The metabolites were hydrolyzed again with beta-glucosidase and 2-chloro-5-hydroxybenzenesulfonamide was released from metabolite B and 2-chloro-5-hydroxy-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl] benzenesulfonamide was released from metabolite A.

The metabolism study on barley involved treating both greenhouse and field-grown barley with ^{14}C-phenyl-labeled chlorsulfuron at rates of 100 and 40 gms/hectare respectively. For the field-grown barley, the plants were about six inches high when treated and the plants were sampled at 1, 2, and 4 weeks post-treatment and at maturity. Treated leaves and new growth were analyzed separately.

For the greenhouse barley experiment, the plants were treated at the four-leaf stage and sampled one week after application.

Both sets of samples were worked up for quantitation and identification of radioactive residues as described above for wheat.

Radioactivity in the treated field-grown barley foliage ranged from <0.067

to 0.117 ppm. Residues in new growth, including grain, ranged from <0.005 to 0.034 ppm. Metabolites A and B comprised the major portion of the radioactive residue in barley samples, although some parent and 2-chlorobenzenesulfonamide were also observed. Most of the surface residue (acetone wash fraction) was chlorsulfuron. Metabolite A accounted for the major portion of the radioactivity after 1 week but decreased at longer times. This decrease was accompanied by corresponding increases in metabolite B. After hydrolysis with beta-glucosidase, metabolites A and B released the same hydroxylated compounds observed in treated wheat.

The metabolism of chlorsulfuron in wheat and barley probably involves both a minor pathway reflecting initial hydrolysis to form 2-chlorobenzenesulfonamide which is then hydroxylated in the phenyl ring followed by conjugation with glucose moieties. The major pathway for metabolism in the subject crops, however, appears to be initial hydroxylation of the phenyl ring followed by glucose conjugation through this hydroxy group. This conjugate (metabolite A) can then undergo hydrolysis to form the conjugate form of 2-chloro-5-hydroxybenzenesulfonamide (metabolite B).

Based on the wheat and barley metabolism studies, we conclude that the nature of the residue in the subject crops is adequately understood. The terminal residue of concern will consist of chlorsulfuron, its hydrolysis product 2-chlorobenzenesulfonamide and conjugates of 2-chloro-5-hydroxy-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) aminocarbonyl] benzenesulfonamide and 2-chloro-5-hydroxybenzenesulfonamide.

Tox Branch has concluded (Memo of June 10, 1982, C. Frick, PP# 2F2604) however, that they would not be concerned over the presence of residues of 2-chlorobenzenesulfonamide or 2-chloro-hydroxybenzenesulfonamide in small grains, therefore chlorsulfuron and 2-chloro-5-hydroxy-N-[(4-methoxy-6-methyl-1,3.5-triazin-2-yl) aminocarbonyl] benzesulfonamide (5-hydroxychlorsulfuron) including its conjugates will comprise the terminal residue of concern in small grains.

Any future uses of chlorsulfuron which result in the occurrence of significant residues in crops may require additional metabolism studies.

Animals

Metabolism studies in rats and lactating goats were submitted in this petition (See PP# 2F2604/EPA Accession No. 070471). These are discussed below. An earlier rat study was submitted in conjunction with PP# 0G2376 (EPA Accession No. 099459) and reviewed therein. (See memo of October 17, 1980, E. Zager.)

The rat study reflected giving 4 groups of rats the following doses of ^{14}C-phenyl-labeled chlorsulfuron. Group A received a single intravenous dose of 0.11 mg/kg. Groups B, C, and D received a single oral dose of the labeled chlorsulfuron at levels of 16, 16, and 3000 mg/kg. Groups B and D rats were not preconditioned with chlorsulfuron while Group C rats received a diet of unlabeled chlorsulfuron at 100 ppm in the diet for 21 days prior to the radioactive dose. Immediately after medication all rats were placed in metabolism chambers.

Urine and feces were collected at 6 and 24 hours post-dosing and then daily until sacrifice. Carbon dioxide and any volatile material were collected from certain animals in Groups A and B. Group A rats were sacrificed at 96 hours. Groups B and C rats were sacrificed after 72 hours and two Group D rats were killed at 72 hours and two were sacrificed after 168 hours. At sacrifice, blood, organs, and tissue were sampled. All samples were counted, extracted, cleaned-up and identified *via* mass spectrometry and TLC.

The major portion of the radioactive dose was excreted in the urine and feces of all the groups of rats with the larger percentage of the dose occurring in the urine. Most of the radioactivity was excreted within 48 hours of treatment.

Radioactive residues in blood and tissues ranged from <0.001 to 0.006 ppm in Group A rats, from <0.02 to 2.57 ppm in Group B rats, from 0.03 to 0.31 ppm in Group C rats and from 0.9 to 6114.6 ppm in Group D rats. Radioactivity was fairly uniformly distributed over the various organs and tissues for all groups of rats with somewhat higher values being observed in liver and kidney. No labeled CO_2 or volatiles were detected from any of the rats where the expired air was collected.

Metabolites which were observed in the rat groups included 2-chlorobenzenesulfonamide and two other materials labeled A and B. The major portion of the radioactivity in urine consisted of parent (67.6 to 98.5%) in all rat groups. In the four groups, 2-chlorobenzenesulfonamide comprised 0.1 to 7.3% of the total radioactivity and metabolites A and B made up 1.3 to 24.4% of the total radioactivity. In all, at least *ca* 75% of the total radioactivity in urine was identified as parent or 2-chlorobenzenesulfonamide.

In rat feces radioactive residues were comprised of 69.2 to 91.4% of chlorsulfuron, 0.6 to 8.5% 2-chlorobenzenesulfonamide and 5.3 to 20.1% metabolite B. In all, >70% of the residue was identified again as parent and 2-chlorobenzenesulfonamide.

Rat tissues were extracted with n-hexane, ethyl acetate and methanol and 86.8 to nearly 100% of the radioactivity was extracted in the last two solvent fractions for all samples. TLC of the concentrated ethyl acetate and methanol extracts showed that the only radioactivity on the plates was comprised of chlorsulfuron and 2-chlorobenzenesulfonamide.

The metabolism of chlorsulfuron in rats occurs mainly via hydrolysis to 2-chlorobenzenesulfonamide. The rate of hydrolysis appears to be rather slow since over 50% of the residue in tissue was observed to be parent compound. Chlorsulfuron and its hydrolysis product 2-chlorobenzene-sulfonamide are excreted mainly in the free form in the rat.

The first lactating goat experiment involved five daily doses of ^{14}C-phenyl-labeled chlorsulfuron at approximately 7.1 ppm in the diet. Milk was collected twice daily and urine and feces were sampled each day. The animal was sacrificed 24 hours after the last treatment and various tissues were sampled. Approximately 85% of the radioactivity administered was excreted in the urine with another 9% excreted in the feces.

Radioactive residues appeared to plateau in the milk after the first day with levels ranging from 0.007 to 0.011 ppm. Residues in tissues and blood ranged from <0.005 to 0.028 ppm (blood). The highest level in tissue was 0.022 ppm observed in the kidney. Radioactivity was characterized only in the urine and feces. No attempt to identify the small amounts of radioactivity in tissues was made.

Analysis of the radioactivity in the urine involved TLC which indicated a very polar material. This material was adjusted to pH 5.0 and treated with beta-glucuronidase at 36° for 24 hours. The hydrolyzed sample was diluted with water, neutralized and extracted with ethyl acetate. The ethyl acetate was removed and the sample was taken up in methanol and applied to a TLC plate. Radioactive bands were scraped from the developed plate and further identified via mass spectrometry. From the TLC_{Rf} values and mass spectroscopic data, it was determined that enzymatic hydrolysis released parent and 2-chlorobenzenesulfonamide in the ratio of 92% to ca 8% respectively. Thus it appears that chlorsulfuron residues are excreted in the urine as glucuronides.

Feces samples were extracted with ethyl acetate and water. Both extracts were concentrated and applied to TLC plates in methanol. The ethyl acetate and water removed 26 and 47% of the radioactivity in the feces. The ethyl acetate extract consisted of free chlorsulfuron (23%) and some 2-chlorobenzenesulfonamide (ca 3%). Radioactivity in the water extract was comprised of polar material and a small amount of beta-glucuronidase as described for urine above. This enzymatic hydrolysis released parent compound (66% of radioactivity residues) and also provided some 2-chlorobenzenesulfonamide and other unidentified materials.

Excretion of ingested chlorsulfuron in ruminants appears to occur primarily as glucuronide conjugates of parent and its hydrolysis product 2-chlorobenzenesulfonamide as opposed to elimination as free compounds in the rat. This conjugation prior to excretion indicates that chlorsulfuron is absorbed by ruminants with subsequent conjugation occurring in the liver. Since no identification of radioactivity in milk or tissues was attempted, no conclusions regarding the nature of the residue in these commodities when chlorsulfuron is fed to ruminants can be made from this experiment.

The second lactating goat study reflected feeding of ^{14}C-phenyl-labeled chlorsulfuron treated wheat forage for six consecutive days. The total radioactive residue in the foliage reflected 1.5 ppm in the diet. The radioactivity was comprised of approximately 55% of the conjugated 5-hydroxyphenyl analog of chlorsulfuron, (metabolite A), about 14% of the conjugate of 2-chloro-5-hydroxybenzenesulfonamide (metabolite B), and ca 20% of parent compound. Milk, feces, and urine were collected daily. The goat was sacrificed the morning of the 7th day and blood and various tissues were sampled.

Radioactive residues plateaued in milk after ca 24 hours. Levels ranged from 0.0009 to 0.002 ppm in milk. About 67 and 27% of the administered dose was excreted in the feces and urine respectively. Radioactivity in blood and various tissues ranged from <0.001 to 0.01 ppm (blood and bladder). In all, 96% of the radioactivity given the goat was recovered.

Radioactive residues were characterized only in the urine and feces. Urine samples were chromatographed directly on TLC plates or acidified and heated with beta-glucuronidase as described in the initial goat study above. Another sample of urine was hydrolyzed with beta-glucosidase at pH 5.0 as described in the wheat metabolism study above. Feces samples were extracted with 80:20 acetone/water, centrifuged, decanted and the excess acetone was stripped off on a rotary evaporator. The solution was acidified and extracted with ether and then with n-butanol. The ether and n-butanol extracts were taken to dryness and the residue dissolved in methanol and applied to TLC plates for identification of the radioactivity.

Radioactive residues identified in urine were parent (44%), 5-hydrodxychlorsulfuron (40%), 2-chloro-5-hydroxybenzenesulfonamide (13%) and 2-chlorobenzenesulfonamide.

Most of the radioactivity in feces was found in the ether solution indicating that the radioactive residues were not conjugated. Residues identified were 5-hydroxychlorsulfuron (80%), 2-chloro-5-hydroxybenzene-sulfonamide (15%), and chlorsulfuron (4%).

When wheat containing weathered residues of chlorsulfuron is fed to a ruminant, conjugates of the metabolites are hydrolyzed and the residues are excreted mainly in the feces in free form. However, some residues are absorbed and converted to corresponding glucuronides in the liver. Glucuronides produced in the liver include those of parent, 5-hydroychlor-sulfuron, 2-chlorbenzenesulfonamide, and 2-chloro-5-hydroxybenzenesulfonamide.

The metabolism of chlorsulfuron in ruminants and poultry is not adequately delineated at this time since no identification of radioactive residues in tissues and milk was performed, nor was a poultry metabolism study conducted.

TOX has concluded (Memos of April 14, 1982, R. Perfetti and June 10, 1982 C. Frick in PP# 2F2604/EPA Accession No. 070762) however that they would not be concerned over the identity of up to 0.22 ppm (kidney) of radioactivity in cow tissue and up to 0.011 ppm in milk based on the feeding of 7.1 ppm of radiolabeled chlorsulfuron in the diet of a lactating goat. Additionally, they do not consider toxicologically significant expected low levels of unidentified residues in poultry and eggs which may result from the feeding of grain containing non-detectable residues of chlorsulfuron. Based on these conclusions, no additional animal metabolism studies are required at this time. Any future uses of chlorsulfuron which result in significant residues in feed items will engender the need for additional animal metabolism studies. For the purposes of tolerances in meat and milk, the residue in these commodities will be regulated in terms at chlorsulfuron per se for the present.

Analytical Methods

The method used to obtain residue data determines chlorsulfuron only using hplc equipped with a Tracor Model 965 photoconductivity detector (PP# 2F2604/EPA Accession No. 070471). Briefly, the method involves extraction with ethyl acetate followed by removal of the ethyl acetate on a rotary evaporator. The residue is then taken up in methylene chloride

and pH 10 phosphate buffer is added. The methylene chloride is stripped off and the solution is cooled and filtered on a Millipore glass filter. At this point, certain samples (green plant and oat grain samples) require a size exclusion clean-up step. This clean-up is as follows:

The aqueous filtrate is acidified to pH 2 and extracted with chloroform. The sample is taken to dryness, dissolved in 25% toluene:ethyl acetate and applied to a size exclusion chromatographic column with 25% toluene:ethyl acetate as the mobile phase. The sample is collected, the solvent is stripped off, and the residue is dissolved in pH 10 phosphate buffer. These samples are then taken through the solvent extraction cleanup as with other substances.

The solvent extraction clean-up involves washing the aqueous buffer with chloroform followed by cyclohexane. The aqueous phase is then acidified to pH 2 and extracted with chloroform. The chloroform extracts are taken to dryness, redissolved in the hplc mobile phase, and analyzed for chlorsulfuron.

Validation data submitted reflected fortification of barley and wheat seeds, straw and wheat, oat and rye plants at 0.01 to 0.2 ppm. Recoveries ranged from 50 to 90% with <50% of the recoveries being greater than 70%. Blank crop values ranged from <0.01 to <0.05 ppm for grain, straw, and green foliage. Four typical chromatographs were submitted.

This method ((PP# 2F2604/EPA Accession No. 070471) was modified to determine chlorsulfuron in bovine tissues, feces, urine and milk in conjunction with a feeding study. These modifications are as follows: for milk and urine, the samples are adjusted to pH 2, extracted with toluene and the toluene solution is taken to dryness. The sample is taken up in pH 10 buffer and the solvent extraction steps are continued as above for plant substrates. For feces, liver and muscle samples, the procedure described for grain is used with very minor differences.

For kidney and fat, the samples are extracted with ethyl acetate and concentrated, refrigerated at 5°C overnight, centrifuged and decanted. The samples are then concentrated and taken through the size exclusion clean-up followed by the rest of the normal procedure.

Validation data for milk reflect fortification at 0.01 to 0.08 ppm. Recoveries ranged from 48 to 130% with most values <70%. Control values were all given as <0.01 ppm. Validation data for tissue samples involved fortification at 0.04 to 0.1 ppm and recoveries ranged from 42 to 70% with all values but one $\leq$65%. Control values were again all <0.01 ppm. Sample chromatograms were submitted.

A second method which determines chlorsulfuron, and 2-chloro-5-hydroxy-N-[(4-methoxy-1,3,5-triazin-2-yl)aminocarbonyl]benzenesulfonamide(5-hydroxychlorsulfuron) (metabolite A) after hydrolysis of its glucoside conjugate (PP# 2F2604/EPA Accession No. 070762). Briefly, the method involves blending with aqueous acidic acetone, the solution is then centrifuged and decanted from solids. The procedure is then repeated and all acetone:water solutions are combined. The acetone is stripped under vacuum and the aqueous solution is extracted with methylene chloride.

The methylene chloride layer contains metabolite A. The aqueous layer is acidified, chloroform is added, and the sample is treated with beta-glucosidase at 35°C for 6 hours with shaking. After cooling, the chloroform layer is separated and the chloroform is stripped in vacuo.

The residue is dissolved in acetonitrile, washed with hexane and the sample is again taken to dryness. The residue is then dissolved in a solution containing 750 ml of cyclohexane, 125 ml of isopropanol, 125 ml of methanol and 1 ml of 9 parts glacial acetic acid and 1 part water (called Solution R), further cleaned-up on a Sep-Pak® column and the eluate is taken to dryness. The residue is redissolved in Solution R and analyzed via hplc using a photoconductivity detector with a mercury lamp.

The chlorsulfuron residue in methylene chloride is worked-up by addition of glacial acetic acid and the sample is taken to dryness. The residue is then dissolved in Solution R added to a buffer solution and excess organic solvents are removed under a stream of nitrogen. This aqueous solution is washed with methylene chloride, acidified and extracted with toluene. The toluene extract is taken to dryness after addtion of 1 ml of glacial acetic acid and the residue is redissolved in Solution R, cleaned-up on a silica Sep-Pak® column and the eluate is evaporated to dryness. The residue is again dissolved in Solution R and analyzed via hplc as above for metabolite A.

Validation data submitted for metabolite A reflected fortification of green wheat at 0.05 to 2 ppm and recoveries ranged from 68 to 115%. Green wheat forage was also spiked with 0.05 to 10 ppm of chlorsulfuron and recoveries ranged from 75 to 119%. All check values for metabolite A and chlorsulfuron using the procedure above were given as <0.05 ppm in wheat forage and grain. Sample chromatographs were submitted.

Data for wheat grain reflected fortification levels of 0.05 to 00.2 ppm and recoveries ranged from 73 to 102%.

Successful method trials on meat, milk, kidney and grain have been completed. Recoveries in grain fortified at 0.05 and 0.1 ppm ranged from 64 to 98% for chlorsulfuron and 5-hydroxychlorsulfuron conjugate. Recoveries of chlorsulfuron in meat, milk and kidney ranged from 61 to 104% when fortified at the same levels. The methods employed in the trials were AMR 70-82 and AMR 85-82.

Adequate methods for enforcement of tolerances in wheat, oats and barley forage, grain and straw in terms of parent and 5-hydroxychlorsulfuron and in meat and milk in terms of chlorsulfuron per se are available. Future uses of chlorsulfuron which require additional metabolism studies may also engender the need for submission of additional methodology including validation data, blank crop values and sample chromatograms. Another method trial may also be needed.

Residue Data

Residue data submitted (PP# 2F2604/EPA Accession Nos. 070471, 070762 and 070891) involved 31 studies on wheat, oats and barley carried out in the states of Nebraska (3), Wyoming (1), Kansas (4), Delaware (2), South

Dakota (1), Minnesota (5), Oregon (6), North Dakota (2), California (1), Washington (2) and Oklahoma (4). Twenty six of the studies reflected analysis for chlorsulfuron only with the remaining five involved analysis for parent and 5-hydroxychlorsulfuron.

The experiments reflected post-emergent application of 14.175 to 907.2 gm active ingredient/acre (1 to 64X) in 11 to 50 gallons/acre using ground equipment. In most cases an 80% wettable powder formulation was applied as opposed to the 75% dry flowable formulation proposed for use. No surfactant was employed in general. One trial involved two treatments to wheat one week apart while 5 other studies reflected 2 applications to wheat, barley or oats 4 to 6 months apart. Residues of chlorsulfuron in wheat and barley were all <0.01 ppm for grain and <0.05 ppm for straw after 50 to 257 days. Residues in oat grain and straw were given as <0.02 and <0.05 ppm, respectively, after PHI's of 69 to 249 days. Residues in wheat forage ranged from <0.05 to 5.2 ppm after 0 to 7 days, from <0.05 to 0.15 ppm after 12 to 15 days, and were given as <0.05 ppm for PHI's of 28 to 200 days.

Residue data for chlorsulfuron and 5-hydroxychlorsulfuron involved sampling of green wheat forage grown in Oklahoma (4 studies) and treated with 1 post-emergence application of 0.5 oz of active ingredient/acre (1X rate) in 10 to 28 gallons of water using ground equipment. In three of the studies a surfactant was used and the 75% Dry Flowable Glean formulation was applied in all cases. Residues of chlorsulfuron and metabolite A ranged from 0.5 to 6.2 ppm and from 0.07 to 1.4 ppm, respectively, after 0 or 1 day PHI's. After 3 to 14 days residues of chlorsulfuron ranged from <0.05 to 3.8 ppm and those of metabolite A ranged from 0.3 to 2.9 ppm. The final study involved treatment of wheat grown in Delaware with 0.62 to 5 oz. active ingredient/acre of chlorsulfuron using the 75% Dry Flowable Glean formulation and a surfactant. After 85 days (at maturity) wheat grain was analyzed for metabolite A only, and values were given as <0.05 ppm.

Raw data sheets for all of the residue trials were submitted. Residue trial B-3-L (Hays, Kansas) has conflicting dates appearing on it. It is assumed however that the dates given on a second study carried out in Hays, Kansas (A2-R) also reflect the correct dates for B-3-L.

The raw data sheets submitted for the residue studies have indicated that the wheat, barley and oat samples were stored for periods of 157 to 615 days prior to analysis (Note: In some of the studies we were unable to determine how long the samples were stored but the indication was that they were also stored for substantial periods of time prior to analysis.) In only the Minot, North Dakota experiment were the samples analyzed within 61 days of sampling.

A 1-year storage stability study (PP# 2F2604/EPA Accession No. 070471) in which wheat grain and straw samples were spiked with 0.04 ppm and 0.2 ppm respectively of chlorsulfuron <u>per se</u> was submitted. Samples were analyzed at day zero and at various intervals up to 363 or 364 (straw) days. Either substrate showed <20% of a decrease after the 1-year storage period. Based on this marginally adequate study, we are accepting residue data for grain and straw <u>only</u> in those studies in which samples were stored for less than 365 days.

With respect to forage, documentation that some of the forage samples were analyzed within 3 to 4 months of sampling was submitted. These data show residue levels which are significantly higher than those observed for forage samples stored for longer periods of time indicating that chlorsulfuron residues <u>are</u> degraded during storage.

With respect to residue data for wheat, oats and barley grain and straw, of all of the studies submitted, 12 had grain and straw samples which were known to have been stored for 1 year or less. These studies reflected the states of Kansas, Oregon, Nebraska, Minnesota, North Dakota and Washington. Residue levels in grain and straw are discussed above. While the number of acceptable residue studies on the grain and straw of wheat, oats and barley is rather limited, in light of the low application rates, we conclude that combined residues of chlorsulfuron and its metabolite 5-hydroxychlorsulfuron would not be expected to exceed 0.1 ppm in grain and 0.5 ppm in straw. The higher tolerance level in grains was needed for the following reasons:

1) No storage stability study for 5-hydroxychlorsulfuron in grains was available and the only residue samples of grain analyzed for this metabolite may have been stored up to 10 months.

2) The detection limit for 5-hydroxychlorsulfuron in grain was given as 0.05 ppm.

3) Only 1 residue study was performed in which 5-hydroxychlorsulfuron glycoside was determined in grain.

Even though we have no residue data or storage stability data for 5-hydroxychlorsulfuron in straw it is concluded, based on ^{14}C-studies, that the 0.5 ppm level is adequate to cover residues which may occur.

With respect to forage, since there was some evidence that chlorsulfuron residues degrade during storage and based on available residue data an appropriate tolerance level in wheat, oats and barley forage was estimated to be 20 ppm.

No wheat milling study is needed at this time since, at most, negligible residues of chlorsulfuron in grain, i.e., <0.1 ppm, are expected.

Any future uses of chlorsulfuron which result in significant residues in wheat, oats and barley will engender the need for additional residue studies. These experiments should reflect adequate varietal and geographical representation, the maximum number of treatments and application rates, ground and aerial application, use of the proposed formulation with and without a surfactant and analysis of the appropriate raw agricultural commodities for the terminal residue of concern. A wheat milling study may also be required along with additional metabolism studies. With respect to the wheat milling study, if it is needed, the grain should contain detectable residues of chlorsulfuron/metabolites/conjugates so that for any concentration which occurs in a fraction, a factor can be accurately determined.

Meat, Milk, Poultry and Eggs

Wheat, oats, and barley grain are major feed items comprising up to 80% of the diet of cattle and up to 50% of the diet of poultry. In addition, wheat forage can make up 70% of the diet of dairy cattle. Straw can also be fed to cattle. The only animal feeding study submitted in this petition involved feeding dairy cattle 2, 10, or 50 ppm of chlorsulfuron in the diet for twenty eight days (pp# 2E2604/EPA Accession No. 070471). This study is discussed in detail below.

Three groups of two cows were fed chlorsulfuron for 28 days. A second group of 2 cows was kept as a control. Twenty-four hours after the last treatment, one cow from each group was sacrificed and samples of blood and various tissues were taken. The remaining cow in each feeding group was withdrawn from chlorsulfuron for 8 days and then sacrificed and sampled as above. Milk was sampled daily with one sample each week being separated intc cream and skim milk fractions. A urine and feces sample was taken from each cow once weekly.

Residues of chlorsulfuron per se in composited (AM + PM) whole milk samples were <0.01 ppm at the 2 ppm feeding level, <0.01 to 0.019 ppm at the 10 ppm feeding level, and 0.021 to 0.10 ppm at the 50 ppm level. Residues in milk decreased to <0.01, <0.01, and 0.072 ppm for the 2, 10, and 50 ppm feeding levels, respectively, within 24 hours of withdrawal from chlorsulfuron. All milk samples showed <0.01 ppm of chlorsulfuron after 48 hours of withdrawal. Residues appeared to be higher in evening milk samples than in morning samples ranging up to 0.11 ppm in one PM sample of a cow being fed 50 ppm of chlorsulfuron in the diet. Residues in milk plateaued at ca 3 days after initiation of medication. Separate analyses of cream and skim milk indicated that there is no preference for chlorsulfuron in the fat portion of the milk.

In urine and feces, residues of free chlorsulfuron ranged from 3.9 to 31 ppm and from 0.06 to 0.74 ppm, respectively, depending on the feeding level. The petitioner contends that chlorsulfuron is excreted from the cow as the intact molecule. This is consistent with the goat study discussed earlier in which hydrolysis of urine excreted glucuronide conjugates released parent and 2-chlorobenzenesulfonamide in the ratio of 92 to 8%.

Residues of parent molecule in various tissues ranged from <0.01 ppm to 0.26 ppm in the cow fed 10 ppm of chlorsulfuron and from <0.01 to 0.25 ppm in the cow fed 50 ppm of this compound. The highest residues were observed in liver and kidney. However, detectable residues of chlorsulfuron were observed in muscle. All tissues at either the 10 or 50 ppm feeding levels showed <0.01 ppm of parent molecule after the 8-day withdrawal period. That the residue determined by the method was indeed chlorsulfuron was confirmed by gas chromatography mass spectrometric analysis of methylated sample extracts.

An experiment which attempted to determine whether glucronide conjugates of chlorsulfuron occurred in cattle urine or milk was performed. This experiment involved taking duplicate sets of urine and milk samples, hydrolyzing only one set with beta-glucuronidase, and omitting hydrolysis in the other set of

samples. Analysis of the duplicate sets of samples indicated slightly larger amounts of chlorsulfuron in the hydrolyzed samples but these differences could be accounted for by differences in recovery of chlorsulfuron. The same situation was observed in urine. Thus it would appear that chlorsulfuron does not occur as a glucuronide conjugate in milk nor is it excreted as such a conjugate in urine. This observation of the lack of conjugated chlorsulfuron in cattle urine is in direct conflict with the results of the goat metabolism study discussed above. This discrepancy was satisfactorily addressed during a conference with DuPont held on 3/31/82.

Based on the discussions above, this chemical is classed in category 2 of Section 180.6(a) with respect to meat and milk. Also, based on the rat and ruminant studies submitted it is probable that chlorsulfuron would be placed in category 2 with respect to poultry and eggs, thus requiring establishment of tolerances in terms of parent molecule and metabolites of concern in all four commodities. However, in light of the TOX conclusions discussed in the Nature of the Residue Section above, tolerances on meat and milk are to be established in terms of parent compound only at levels of 0.3 ppm in meat and 0.1 ppm in milk and no tolerances on poultry and eggs are needed at this time.

Any future use of chlorsulfuron which results in significant residues in feed items may require submission of additional ruminant and/or poultry feeding studies, methodology, proposals for higher/new tolerances in meat, milk, poultry and eggs and identification of the terminal residue of concern in these commodities.

Other Considerations

There are no Codex or foreign tolerances established for chlorsulfuron. Therefore, no compatability questions are involved with this petition.

VIII

ECOLOGICAL EFFECTS

Ecological Effects Profile

Data indicate that technical chlorsulfuron is practically nontoxic to most terrestrial wildlife and to aquatic organisms. Overall safety is enhanced by its extremely low use rates. A maximum of 1 ounce/acre will be applied during a 12-month growing season, with many applications made in the 1/4 ounce/acre range. This results in relatively little exposure and essentially no hazard to both terrestrial wildlife and aquatic organisms. For example, if the total 1 ounce application were made to a 1 acre, 1 meter deep pond, the resulting chlorsulfuron levels would only be in the low ppb range.

Acceptable acute oral studies yielded LD_{50} values of greater than 5000 mg/kg for both bobwhite quail (Twigg 1980, MRID #0113-0068) and mallard ducks (Bristol 1980, MRID #0113-0062). Acceptable dietary studies yielded LC_{50} values of greater than 5000 ppm for both bobwhite quail (Beavers 1981, MRID #0113-0061) and mallard ducks (Wentz 1979, MRID #0113-0069).

In acceptable studies, 96-hour LC_{50} values for aquatic organisms were determined to be greater than 300 ppm for bluegill sunfish (Smith 1979a, MRID #0113-0064) and fathead minnnows (Smith 1979c, MRID #0113-0066), greater than 250 ppm for rainbow trout (Smith 1979d, MRID #0113-0067), and greater than 40 ppm for channel catfish (Smith 1979b, MRID #0113-0065). The 48-hour LC_{50} to daphnia Magna was 370 ppm (Goodman 1979, MRID #0113-0063). Additionally, residues were found not to accumulate in the edible tissues of the fish.

Summary of Major Data Gaps

There are no data gaps in Ecological Effects.

Guide to Use of This Bibliography

1. CONTENT OF BIBLIOGRAPHY. This bibliography contains citations of all studies considered relevant by EPA in arriving at the positions and conclusions stated elsewhere in the Standard. Primary sources for studies in this bibliography have been the body of data submitted to EPA and its predecessor agencies in support of past regulatory decisions. Selections from other sources, including the published literature, in those instances where they have been considered, will be included.

2. UNITS OF ENTRY. The unit of entry in this bibliography is called a "study." In the case of published materials, this corresponds closely to an article. In the case of unpublished materials submitted to the Agency, the Agency has sought to identify documents at a level parallel to the published article from within the typically larger volumes in which they were submitted. The resulting "studies" generally have a distinct title (or at least a single subject), can stand alone for purposes of review, and can be described with a conventional bibliographic citation. The Agency has attempted also to unite basic documents and commentaries upon them, treating them as a single study.

3. IDENTIFICATION OF ENTRIES. The entries in this bibliography are sorted numerically by "Master Record Indentifier," or MRID, number. This number is unique to the citation, and should be used at any time specific reference is required. It is not related to the six-digit "Accession Number" which has been used to identify volumes of submitted studies; see paragraph 4(d)(4) below for a further explanation. In a few cases, entries added to the bibliography late in the review may be preceded by a nine-character temporary identifier. These entries are listed after all MRID entries. This temporary identifier number is also to be used whenever specific reference is needed.

4. FORM OF ENTRY. In addition to the Master Record Identifier (MRID), each entry consists of a citation containing standard elements followed, in the case of materials submitted to EPA, by a description of the earliest known submission. Bibliographic conventions used reflect the standards of the American National Standards Institute (ANSI), expanded to provide for certain special needs.

   a. Author. Whenever the Agency could confidently identify one, the Agency has chosen to show a personal author. When no individual was identified, the Agency has shown an identifiable laboratory or testing facility as author. As a last resort, the Agency has shown the first known submitter as author.

   b. Document Date. When the date appears as four digits with no question marks, the Agency took it directly from the document. When a four-digit date is followed by a question mark, the bibliographer deduced the date from evidence in the document. When the date appears as (19??), the Agency was unable to determine or estimate the date of the document.

c. Title. In some cases it has been necessary for Agency bibliographers to create or enhance a document title. Any such editorial insertions are contained between square brackets.

d. Trailing Parentheses. For studies submitted to the Agency in the past, the trailing parentheses include (in addition to any self-explanatory text) the following elements describing the earliest known submission:

(1) Submission Date. Immediately following the word 'received' appears the date of the earliest known submssion.

(2) Administrative Number. The next element, immediately following the word 'under', is the registration number, experimental permit number, petition number, or other administrative number associated with the earliest known submission.

(3) Submitter. The third element is the submitter, following the phrase 'submitted by'. When authorship is defaulted to the submitter, this element is omitted.

(4) Volume Identification (Accession Numbers). The final element in the trailing parentheses identifies the EPA accession number of the volume in which the original submission of the study appears. The six-digit accession number follows the symbol 'CDL', standing for "Company Data Library." This accession number is in turn followed by an alphabetic suffix which shows the relative position of the study within the volume. For example, within accession number 123456, the first study would be 123456-A; the second, 123456-B; the 26th 123456-Z; and the 27th 123456-AA.

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Registration Standard Bibliography
Case 0113 Chlorsulfuron

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Citations Considered to be Part of the Data Base
Supporting Registration Under the Standard
(References Listed by MRID Numbers)

MRID	Citation
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0113-0002	E. I. du Pont de Nemours & Company (1981a)
0113-0003	E. I. du Pont de Nemours & Company (1981b)
0113-0004	E. I. du Pont de Nemours & Company (1981c)
0113-0005	E. I. du Pont de Nemours & Company (1981d)
0113-0006	E. I. du Pont de Nemours & Company (1981e)
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0113-0009	Chrzanowski, R. L. (1980)
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0113-0020	Han, J. C-Y (1981e)
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Case 0113 Chlorsulfuron

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Product Chemistry

MRID	Citation
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0113-0002	E. I. du Pont de Nemours & Company (1981a) Analysis for Nitrosamines. (Unpublished study received November 13, 1981, under 352-UNU; CDL:070470).
0113-0003	E. I. du Pont de Nemours & Company (1981b) Composition of Technical Chlorsulfuron. (Unpublished study received November 13, 1981, under 352-UNU; CDL:070470).
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0113-0005	E. I. du Pont de Nemours & Company (1981d) Manufacturing Process and Impurities Formed. (Unpublished study received November 13, 1981, under 352-UNU; CDL:070470).
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0113-0008	Rapisarda, C.; Shrivastava, S. P.; Butler, L. D. (1981) Physical Properties of DPX-4189: Octanol/Water Partition Ratio, Solubilities, and Soil Adsorption Data (K-Values and TLC (R_f) Values) (AMR-28-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).

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Environmental Fate

MRID	Citation
0113-0009	Chrzanowski, R. L. (1980) Soil Column Adsorption Studies with ^{14}C-DPX-4189 Herbicide on Soils (AMR-08-80B). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0010	Chrzanowski, R. L. (1981a) Degradation of ^{14}C-DPX-W4189 in Anaerobic Aquatic Environments (AMR-38-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0011	Chrzanowski, R. L. (1981b) Soil Column Leaching Studies with (^{14}C)-DPX-4189 (AMR-26-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0012	E. I. du Pont de Nemours & Company (1981g) Glean™ Aerial Drift Study. (Unpublished study received December 28, 1981, under 352-UNU; CDL:070534).
0113-0013	Han, J. C-Y. (1980a) Aerobic Soil Metabolism of ^{14}C-Phenyl Labeled DPX-4189 (AMR-08-80C). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0014	Han, J. C-Y. (1980b) Hydrolysis and Photolysis Studies with ^{14}C-DPX-4189 (AMR-08-80A). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0015	Han, J. C-Y. (1980c) Field Soil Disappearance Studies with ^{14}C-Labeled DPX-4189 (AMR-08-80D). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0016	Han, J. C-Y. (1981a) ^{14}C-DPC-W4189 Soil Disappearance Studies in the Field (AMR-54-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).

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MRID	Citation
0113-0017	Han, J. C-Y. (1981b) Hydrolysis of ^{14}C-Labeled DPX-W4189 (AMR-39-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0018	Han, J. C-Y. (1981c) Crop Rotation Studies with ^{14}C-DPX-W4189 in the Field (AMR-46-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0019	Han, J. C-Y. (1981d) Photolysis of ^{14}C-Phenyl Labeled DPX-W4189 on Soil (AMR-42-81). (Unpublished study received November 13, 1981, under 352-UNU: submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0020	Han, J. C-Y. (1981e) Residue Studies with [^{14}C]-DPX-4189 in Bluegill Sunfish (AMR-32-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0021	Han, J. C-Y. (1981f) Residue Studies with Glean™ Weed Killer in Channel Catfish (AMR-45-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0022	Han, J. C-Y., Smith, G. A. (1980) Evaluation of Possible Effects of DPX-4189 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazine-2-yl)aminocarbonyl]benzenesulfonamide on Nitrifying Bacteria in Two Soil Types (AMR-14-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0023	Julis, A. Jay (1980) The Effect of DPX-4189 on Microorganisms and Microbial Populations of Soils (AMR-13-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0024	Rapisarda, C. (1981a) Microbial Degradation of ^{14}C-DPX-4189 in Soil (AMR-43-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).

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MRID	Citation
0113-0025	Rapisarda, C. (1981b) Rotational Crop Studies with ^{14}C-Phenyl Labeled DPX-W4189 in the Greenhouse (AMR-49-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).
0113-0008	Rapisarda, C.; Shrivastava, S. P.; Butler, L. D. (1981) Physical Properties of DPX-4189: Octanol/Water Partition Ratio, Solubilities, and Soil Adsorption Data (K-Values and TLC (R_f) Values) (AMR-28-81). (Unpublished study received November 13, 1981, under 352-UNU; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070470).

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0113-0026	Ashley, P. (1980) Acute Skin Absorption LD_{50} Test on Rabbits (HLR 505-80). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0027	Brittelli, M. R. (1976) Eye Irritation Test in Rabbits (HLR 744-76). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0028	Edwards, D. F. (1979) Acute Skin Absorption Test on Rabbits - LD_{50} (HLR 415-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0029	Ferenz, R. (1980) LC_{50} Inhalation Test - Albino Rats (HLR 129-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0030	Fieser, Stephen (1980) Dominant Lethal Evaluation in Rats (HLO-789-80). (Unpublished study received November 13, 1981, under 2F2604; prepared by Hazleton Laboratories, submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0031	Galloway, Sheila M. (1981) Mutagenicity Evaluation of 12,700 in an *In Vitro* Cytogenetic Assay Measuring Chromosome Aberration Frequencies in Chinese Hamster Ovary (CHO) Cells (HLO-323-81). (Unpublished study received November 13, 1981, under 2F2604; prepared by Litton Bionetics, submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0032	Goodman, N. C. (1976) Primary Skin Irritation and Sensitization Test on Guinea Pigs (HLR 794-76). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).

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MRID	Citation
0113-0033	Hall, J. A. (1980) Oral LD_{50} Test in Guinea Pigs (HLR 308-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0034	Henry, J. E. (1977) Ten-Dose Oral Subacute Test (HLR 97-77). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0035	Hinckle, L. (1979) Intraperitoneal LD_{50} Test (HLR 403-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0036	Hinckle, L. (1981) Oral LD_{50} Test in Rat (HLR 74-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0037	Hoberman, Alan M. (1980) Teratology Study in Rabbits (HLO-534-80). (Unpublished study received November 13, 1981, under 2F2604; prepared by Hazleton Laboratories, submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0038	Hunt, Oliver R. (1981) Metabolism of ^{14}C-DPX-W4189 by Rats (AMR-53-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0039	Rogers, A. S.; Culik, R. (1978) Teratological Study of 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]-benzenesulfonamide (INW-4189) in Rats (HLR 583-78). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099461).

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MRID	Citation
0113-0040	Russel, James F., Jr. (1977) Mutagenic Activity of Benzenesulfonamide, 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl] in the Salmonella/Microsome Assay (HLR 121-77). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099461).
0113-0041	Schneider, P. W., Jr. (1980) Six-Month Feeding Study in Dogs with 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-aminocarbonyl]benzenesulfonamide (INW-4189) (HLR 108-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099461).
0113-0042	Shrivastava, S. P. (1980) Metabolism of ^{14}C-DPX-4189 by Rats (AMR-08-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099461).
0113-0043	Silber, L. S. (1980a) Eye Irritation in Rabbits (HLR 1034-80). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0044	Silber, L. S. (1980b) Primary Skin Irritation and Sensitization Test on Guinea Pigs (HLR 1073-80). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0045	Silber, L. S. (1980c) Skin Irritation Test on Rabbits (HLR 355-80). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0046	Smith, L. W. (1980) Ninety-Day Range-Finding Feeding Study with 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]-benzenesulfonamide (INW-4189) in Mice (HLR 69-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099461).

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MRID	Citation
0113-0047	Tong, C.; Shimada, T.; Williams, G. M. (1981) The Hepatocyte Primary Culture/DNA Repair Assay on Compound 12,700 Using Rat Hepatocytes in Culture (HLO-794-81). (Unpublished study received December 28, 1981, under 2F2604; prepared by Naylor Data Institute, submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070534).
0113-0048	Trivits, R. L. (1979) Oral LD_{50} Test in Fasted Male and Female Rats (HLR 399-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0049	Waterer, Judith C. (1980) Chinese Hamster Ovary Cell Assay for Mutagenicity (HLR 475-80). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0050	Wood, C. K. (1981) Ninety-Day Feeding Study with 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]-benzenesulfonamide (INW-4189) in Rats (HLR 80-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099460).
0113-0051	Wood, C. K. (1981a) Long-Term Feeding Study with 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benzene-sulfonamide (INW-4189) in Mice (HLR 838-81). (Unpublished study received December 28, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL: 070535 to 070540).
0113-0052	Wood, C. K. (1981b) Long-Term Feeding Study with 2-Chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]-benzenesulfonamide (INW-4189) in Rats (HLR 557-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070472 to 070476).

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Residue Chemistry

MRID	Citation
0113-0053	E. I. du Pont de Nemours & Company (1981h) Tables I to IV, Section D. (Unpublished study received November 13, 1981, under 2F2604; CDL:070471).
0113-0054	Han, J. C-Y. (1981g) The Fate of the Major Wheat Metabolite of ^{14}C-DPX-W4189 in the Lactating Goat (AMR-52-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0055	Han, J. C-Y. (1981h) ^{14}C-DPX-W4189 Metabolism in Barley (AMR-55-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0056	Han, J. C-Y. (1981i) ^{14}C-DPX-W4189 Metabolism in Greenhouse and Field Grown Wheat (AMR-47-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0057	Han, J. C-Y. (1981j) Metabolism of ^{14}C-DPX-4189 in the Lactating Nanny Goat (AMR-29-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0037	Hunt, Oliver R. (1981) Metabolism of ^{14}C-DPX-W4189 by Rats (AMR-53-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0041	Shrivastava, S. P. (1980) Metabolism of ^{14}C-DPX-4189 by Rats (AMR-08-80). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099461).
0113-0058	Slates, R. V. (1981) Determination of DPX-4189 Residues in Grain, Straw, and Green Plants of Cereal by High Performance Liquid Chromatography (AMR-04-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).

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Residue Chemistry

MRID	Citation
0113-0059	Slates, R. V.; Moore, D. W. (1981) Fate of DPX-W4189 Ingested by Dairy Cattle (AMR-48-81). (Unpublished study received November 13, 1981, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070471).
0113-0060	Zahnow, E. W. (1982) Analysis of Chlorsulfuron and Metabolite A (AMR-70-82). (Unpublished study received April 9, 1982, under 2F2604; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070762-A).

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Ecological Effects

MRID	Citation
0113-0061	Beavers, Joann B. (1981) Eight-Day Dietary LD_{50} Bobwhite Quail (HLO-806-81). (Unpublished study received December 28, 1981, under 352-UNU; prepared by Wildlife International Ltd., submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:070534).
0113-0062	Bristol, Kenneth L. (1980) Acute Oral LD_{50} Study in Mallard Ducks (HLO-289-80). (Unpublished study received June 10, 1980, under 0G2376; prepared by Hazleton Laboratories, submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0063	Goodman, Nancy C. (1979) 48-Hour LC_{50} to Daphnia Magna (HLR 152-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0064	Smith, Edward J. (1979a) 96-Hour LC_{50} to Bluegill Sunfish (HLR 385-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0065	Smith, Edward J. (1979b) 96-Hour LC_{50} to Channel Catfish (HLR 856-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0066	Smith, Edward J. (1979c) 96-Hour LC_{50} to Fathead Minnows (HLR 384-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0067	Smith, Edward J. (1979d) 96-Hour LC_{50} to Rainbow Trout (HLR 386-79). (Unpublished study received June 10, 1980, under 0G2376; submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).
0113-0068	Twigg, Carol J. (1980) Acute Oral LD_{50} Study in Bobwhite Quail (HLO-290-80). (Unpublished study received June 10, 1980, under 0G2376; prepared by Hazleton Laboratories, submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).

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MRID	Citation
0113-0069	Wentz, Krista T. (1979) Avian Dietary Toxicity (LC_{50}) in Mallard Ducks (HLO-565-79). (Unpublished study received June 10, 1980, under 0G2376; prepared by Hazleton Laboratories, submitted by E. I. du Pont de Nemours & Company, Wilmington, DE; CDL:099462).

REFERENCE KEY TO MRID NUMBER

The permanent MRID numbers for citations in this Standard were not available when the Standard was written. The following lists provide a crosswalk between the temporary number which was assigned and the permanent MRID number. The MRID number should be used when citing a particular study.

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